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1651

FOSSIL FRUIT FROM THE LOWER CHALK OF ROCHESTER, KENT

In the National Collection, British Museum.

S. J. Mackie, F.G.S., del.

THE GEOLOGIST;

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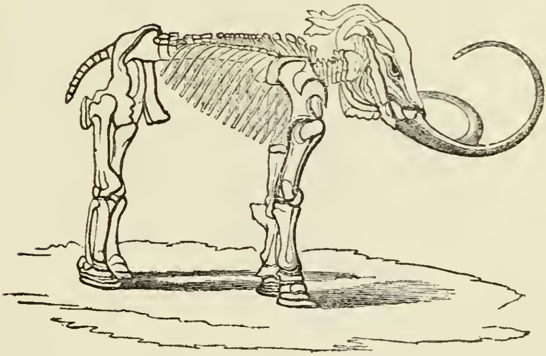
OF

GEOLOGY.

EDITED BY S. J. MACKIE, F.G.S., F.S.A.



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PREFACE.

Few people know the cost, time, toil, trouble, and determination necessary to establish a magazine. This cost, toil, and trouble have been borne by me, and that too through a period of my life when of all others I was least able to sustain it. Five volumes completed, however, show what determination, perseverance, and tenacity have accomplished, and to what result we have attained. It is true our price is higher, but may we not fairly ask, Is not our quality better? Special scientific periodicals cannot be increased in circulation like ordinary periodicals by advertisements. There are but so many geologists, and advertisements do not increase their number. They may increase the casual sale, but not the permanent purchasers; and commercially 'The Geologist' must be maintained remunerative to ensure its permanency. I have two reasons in referring to this topic at the present time,—*first*, to enjoy the gratification I always look forward to at this congenial season of sincerely thanking my many good friends; and secondly, that it may be distinctly known that I take the warmest interest in the profitable continuance of this Magazine; the increased success of which will yield a corresponding benefit to myself as well as to the publisher.

Not the least gratifying fact is the good opinion held of this Magazine abroad. From America, France, Switzerland, Austria, Prussia, Italy, and Germany, we have received many complimentary opinions, but these expressions will be to us only the incentive to do better work to more richly deserve them. For contributions to the present volume our best thanks must be offered to Sir Roderick Murchison, Mr. C. Carter Blake, Mr. Pengelly, Mr. J. Elliott, Mr. S. P. Woodward, Mr. Andrew Taylor, Dr. Rubidge, Professor T. Rupert Jones, Mr. W. Murray, the Rev. S. Lucas, Count Marschall, Director Haidinger, Professor King, Professor Huxley, Professor Busk, Professors Dana and Silliman, Mr. Du Noyer, Mr. Guppy, Mr. Wyatt, Dr. Wilkins, Mr. James Plant, Mr. Bensted, Mr. John Taylor, Dr. Gibb, Rev. Hugh Mitchell, Professor Ansted, Professor Harkness, Mr. Charles Moore, Mr. Wynne, Mr. Sorby, Mr. Davidson, Mr. C. B. Rose, Rev. J. Crompton, and Mr. W. Bollaert.

S. J. MACKIE.

THE GEOLOGIST.

JANUARY 1862.

SOME FOSSIL FRUITS FROM THE CHALK.

We are not ashamed to confess our ignorance when we meet with anything we do not understand. On the contrary, we regard such confessions as one of the roads to knowledge; and we always wished it to be one of the features of this magazine that matters not understood should be brought before the world in its pages. We set the example ourselves in the most prominent part of our journal—its opening pages.

Few things are so little understood as fossil vegetables, and least of all are fossil fruits.

Some new species from the lower chalk of Rochester have just

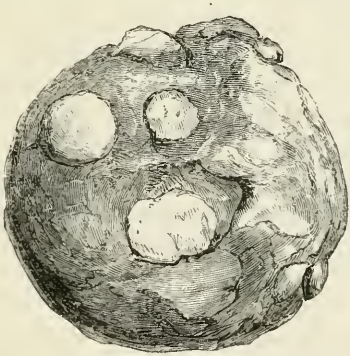


Fig. 1.

been added to the national collection in the British Museum, and we lay our drawings of them before our readers with the frank admission that we do not know what they are, and we ask as frankly for information or suggestions.

Some indeed, such as the coffee-like berries, fig-like fruits, and nipadites of the London Clay, carry in themselves the palpable evidence of the classes to which they belong; but there are many specimens from other rocks remaining undescribed in many a collector's cabinet from the want of the ability to give anything like a reasonable suggestion as to what they were, and often, indeed, from the sheer incapacity to assign to them even any probable affinities.

And there they will lie and rot, possibly, if their owners are not bold enough to confess their ignorance and ask for information. For them our pages offer a means of inquiry which they do not possess for us. *Anonymously* they can ask *their* questions; *openly* we must ask *ours*. These chalk fruits puzzle us, we confess it. Not because we could not soon find some fruits like them in outward form and shape, but because we really do not understand their mode of preservation. Any one can see from our drawings (Plate I., and woodcut, fig. 1) that, flattened as they now are, such flattening is due to pressure in the substance of the rock, and that originally they were round in form. As they are preserved, they are roundish lumps of chalk enveloped in a dark brown ochreous skin.

A superficial observer might look upon this ochreous skin as the real rind of the fruit, but these fruit-masses are perforated by large teredines (see woodcut, fig. 1), as if the central part of the fruit had been of a solid nut-like character, such as we see in the vegetable ivory.

And yet, if this were so,—and teredines bore we know only in hard substances,—how is it that the central solid part has all rotted away, and its place been supplanted with the same soft calcareous chalk as the stratum in which the fossils were imbedded, while the more tender skin only is preserved?

In the same beds of chalk with the fruits, there are not uncommonly to be met with fragments of fossil wood, reduced likewise to thin skin-like ochreous layers, and bored too, through and through, by teredos. These not only show the rotting away of the solid fibrous wood, but also its reduction to the film-like state in which we see it spread on the surface of the chalk. But these wood-fragments might have lain on the still, slowly accumulating surface of the cretaceous ocean-bottom, and have rotted down to their last pellicle in the ponderous lapse of time. Not so the fruits: they, if solid, have been hollowed out to their shells and then *filled in*. Whether these fruits and other vegetable remains in the chalk be so rare as has been thought, I somewhat doubt. I have myself collected fragments of fossils from the lower chalk of Dover and of Maidstone, which I believe, since I have seen these specimens, to have been fruits like them—and some few of these I think are still in the Folkestone collection—but in all cases the specimens seem to have suffered much decomposition from long-continued immersion before they were completely imbedded.

Here then, at the very outset, we are met with a difficulty which must be surmounted before we can compare with any usefulness these relics of the arborescent vegetation of the far-distant Cretaceous age with the fruits of any living class of trees. There are some in the botanical collection in Kew Gardens which present many points of similarity, but we should by no means be inclined to say of identity. The greatest mischief to fossil botany has arisen from the fact that many, if not most of our fossil species, have been named and described by men who were not botanists; and as so little is known of the vegetable remains preserved in the English chalk, we refrain from giving, and should hesitate long before we assigned, botanical characters to any new form from that formation, especially when so vaguely preserved as those before us.

We would however suggest that the film-like character of the ochreous envelopes of these fossils may be thus explained:—Supposing the fruits to have been solid nuts contained in a husk like the nipadites,—and in the cases of the British Museum there are fine specimens of nipadites from the middle eocene of Brussels, well riddled with teredines; the same is well known to be the case with the nipadites and other nut-like fruits of the London clay,—while the nuts were in the earliest stage of decay, a film of sulphuret of iron was deposited in the empty interspace between the nut and its outer husk, forming thus, when solidified, a thin metallic paper-like pellicle or case, having on its interior surface the impression of the exterior surface of the kernel, and on its exterior surface that of the interior of the husk. The fruit and husk might both then wholly decay away, and leave this metallic shell to be imbedded and filled in by the natural deposition of the cretaceous mud. Thus it will be desirable in searching for further specimens to look carefully for, and to preserve any fragments of real wood or black charcoal, however small, which may be attached to the inside or outside of the ochreous film, as in these fragments we might get some traces of structure to aid us.

That something like this has taken place seems indicated by the film-like character of such specimens of wood as those we have referred to, in which cases the sulphuret of iron was probably deposited in the fine parting between the wood and the bark. Moreover, the casts of the teredo-holes are covered over with the same film of red oxide of iron, which has resulted from the decomposition at a subsequent period of the sulphuret.

Although we attempt not then to determine their family or genera, we are not doing bad service to science in drawing attention to these fossil cretaceous fruits. The very knowledge of their existence will stimulate other observers to seek for more illustrative examples. What one is defective in, another may possess, and so from one to the other we may gain a general knowledge of the whole organism long before any perfect specimen has been brought to light.

In the present case we submit our plates and figures of these fruits, and leave the honour of naming them open to him who can really tell us What they are.

ON THE INAPPLICABILITY OF THE NEW TERM "DYAS" TO THE "PERMIAN" GROUP OF ROCKS, AS PROPOSED BY DR. GEINITZ.

COMMUNICATED BY

SIR RODERICK IMPEY MURCHISON, F.R.S., D.C.L., LL.D., ETC.,

Director-General of the Geological Survey of Britain.

In the year 1859, M. Marcou proposed to substitute the word "Dyas" for "Permian," and summed up his views by saying that he regarded "the New Red Sandstone, comprising the Dyas and Trias, as a great geologic period, equal in time and space to the Palæozoic epoch or the Greywacke (Silurian and Devonian), the Carboniferous (Mountain-limestone and Coal), the Mesozoic (Jurassic and Cretaceous), the Tertiary (Eocene, Miocene, and Pliocene), and the recent deposits (Quaternary and later)" ! ! *

As that author, who had not been in Russia, criticized the labours and inductions of my associates De Verneuil and Von Keyserling, and myself, in having proposed the word "Permian" for tracts in which he surmised that we had commingled with our Permian deposits much red rock of the age of the Trias, I briefly defended the views

* See 'Dyas et Trias de Marcou,' Bibliothèque Universelle de Genève, 1859.

I had further sustained by personal examination of the rocks of Permian age in various other countries of Europe.*

It was, indeed, evident that M. Marcou's proposed union of the so-called Dyas and Trias in one natural group could not for a moment be maintained, since there is no conclusion on which geologists and palæontologists are more agreed, than that the series composed of Roth-liegende, Kupfer-Schiefer, Zechstein, etc., forms the uppermost Palæozoic group, and is entirely distinct in all its fossils, animal and vegetable, from the overlying Trias, which forms the true base of the Mesozoic or Secondary rocks.

Owing to such a manifest confusion respecting the true palæontological value of the proposed "Dyas," we should probably never have heard more of the word, had not my distinguished friend, Dr. Geinitz, of Dresden, recently issued the first volume of his valuable palæontological work, entitled 'Dyas, oder die Zechstein-Formation und das Rothliegende.'† In borrowing the term "Dyas" from Marcou, Dr. Geinitz shows, however, that that author had been entirely mistaken in grouping the deposits so named with the Trias or the Lower Secondary rocks, and necessarily agrees with me in considering the group to be of Palæozoic age.

As there is no one of my younger contemporaries for whom I have a greater respect as a man of science, or more regard as a friend, than Dr. Geinitz, it is painful, in vindicating the propriety and usefulness of the word "Permian," to be under the necessity of pointing out the misuse and inapplicability of the word "Dyas."

The term "Permian" was proposed twenty years ago for the adoption of geologists, without any reference whatever to the lithological or mineral divisions of the group; for I well knew that a certain order of mineral succession of this group prevailed in one tract, which could not be followed out in another. After surveys, during the summers of 1840 and 1841, of extensive regions in Russia in Europe, in which fossil shells of the age of the Zechstein of Germany, and the Magnesian Limestone of England, were found to occur in several courses of limestone, interpolated in *one great series* of red sandstones, marls, pebble-beds, copper-ores, gypsum, etc., and seeing that these varied strata occupied an infinitely larger superficial area than their equivalents in Germany and other parts of Europe, I suggested to my associates, when we were at Moscow in October, 1851, that we should employ the term "Permian," as derived from the vast government of that name, over which and several adjacent governments we had traced these deposits.

In a letter addressed to the late venerable Dr. Fischer von Waldheim, then the leading naturalist of Moscow, I therefore proposed the term "Permian,"‡ to represent by one unambiguous geographical

* See 'American Journal of Science and Arts,' 2nd ser. vol. xxviii. p. 256,—the work of M. Marcou having attracted more attention in America than in England.

† Leipzig, 1861.

‡ See Leonhard's 'Jahrbuch' of 1842, p. 92; and the 'Philosophical Magazine,'

term a varied mineral group, which neither in Germany nor elsewhere had then received one collective name* adopted by geologists, albeit it was characterized by one typical group only of animal and vegetable remains. As the subdivisions of this group in Germany consisted, in ascending order, of Rothliegende, with its overlying strata of. Weissliegende, Kupfer-Schiefer, and Lower and Upper Zechstein, and in England of Lower Red Sandstone and Magnesian Limestone, with other accompanying sands, marls, etc., so well described by Sedgwick,† the name of "Permian"—purposely designed to comprehend these various strata—was readily adopted, and has since been generally used. Even Geinitz himself, as well as his associate Gutbier, published a work under the name of the 'Permische System in Sachsen.'‡ Naumann has also used the term in reference to the group in other parts of Saxony; whilst Göppert has clearly shown that the rich Permian Flora is peculiar and characteristic of this supra-carboniferous deposit. In England, France, and America no other term in reference to this group has been used for the last fifteen years.

The chief reason assigned by Geinitz for the substitution of the word "Dyas" is, that in parts of Germany the group is divided into two essential parts only—the Rothliegende below, and the Zechstein above, the latter being separated abruptly from all overlying deposits.

Now, not doubting that this arrangement suits certain localities, I affirm that it is entirely inapplicable to many other tracts. For, in other regions besides Russia, the series of sands, pebbles, marls, gypseous, cupriferous, and calcareous deposits form but one great series. In short, the Permian deposits are for ever varying. Thus, in one district they constitute a *Monas* only, in others a *Dyas*, in a third a *Trias*, and in a fourth a *Tetras*.§

In this way many of the natural sections of the north of Germany differ essentially from those of Saxony; whilst those of Silesia differ still more from each other in their mineral subdivisions, as explained

vol. xix. p. 418, "Sketch of some of the Principal Results of a Geological Survey of Russia."

* It is true that the term Pénéen was formerly proposed by my eminent friend, M. d'Omalius d'Halloy; but as that name, meaning *sterile*, was taken from an insulated mass of conglomerate near Malmédy in Belgium, in which nothing organic was ever discovered, it was manifest that it could not be continued in use as applied to a group which was rich in animal and vegetable productions.

† Trans. Geol. Soc. London, New Series, vol. iii. p. 37.

‡ I may here note that the great Damuda formation of Bengal, with its fossil Flora and animal remains, including Saurians and Labyrinthodonts, described by Professor Huxley, has recently been referred (at least provisionally) to the Permian age, by Dr. Oldham, the Superintendent of the Geological Survey of India. In fact, Dr. Oldham actually cites the plant *Tæniopteris*, of the "*Permian beds of Geinitz and Gutbier in Saxony*," in justification of his opinion. See 'Memoirs of the Geological Survey of India,' vol. iii. p. 204.

§ See 'Siluria,' 2nd edit., 1859, and 'Russia in Europe and the Ural Mountains,' 1845.

in 'Siluria,' 2nd edition, particularly at p. 342. Near the northern extremity of the Thüringerwald, for example, and especially in the environs of Eisenach, an enormous thickness of the Rothliegende, in itself exhibiting at least two great and distinct parts, is surmounted by the Zechstein, thus being even so far tripartite, whilst the Zechstein is seen to pass upwards to the east of the town, by nodular limestones, into greenish and red sandy marl and shale, the "Lower Bunter Schiefer" of the German geologists. The same ascending order is seen around the copper-mining tract near Reichelsdorf, as well as in numerous sections on the banks of the Fulda, between Rotheburg and Altmorschen, where the Zechstein crops out as a calcareous band in the middle of escarpments of red, white, and green sandstone.*

But in showing that in many parts of Germany, as well as in England, the Zechstein has a natural, conformable, and unbroken cover of red rock, I never proposed to abstract from the Trias any portion of the Bunter Sandstein or true base of the group, as related to the Muschelkalk by natural connection or by fossils. I simply classed as Permian a peculiar thin red band (Bunter Schiefer), into which I have in many localities traced an upward passage from the Zechstein, and in which no triassic shell or plant has ever been detected.

On my own part, I long ago expressed my dislike to the term Trias; for, in common with many practical geologists who had surveyed various countries where that group abounds, I knew that in numerous tracts the deposits of this age are frequently not divisible into three parts. In central Germany, where the Muschelkalk forms the central band of the group, with its subjacent Bunter Sandstein and the overlying Keuper, the name was indeed well used by Alberti, who first proposed it; but when the same group is followed to the west, the lower of the three divisions, even in Germany, is seen to expand into two bands, which are laid down as separate deposits on the geological maps of Ludwig and other authors. In these countries, therefore, the Trias of Alberti's tract has already become a Tetras. In Britain it parts entirely with its central or calcareous band, the Muschelkalk, and is no longer a Trias; but, consisting simply of Bunter Sandstein below, and Keuper above, it is therefore a Dyas; though here again the Geological Surveyors have divided the group into four and even into five parts, as the group is laid down upon the map—No. 62, 'Geographical Survey of Great Britain.'

The order of succession in the Permian group all along the western side of the Pennine chain or geographical axis of England proves the impossibility of applying to it the word "Dyas;" for over wide

* On two occasions (1853–4) Professor Morris accompanied me, and traced with me these relations of the strata; subsequently, when Mr. Rupert Jones (1857) was my companion, we saw other sections clearly exhibiting this upward transition which I have described. Since then, Professor Ramsay, when at Eisenach, convinced himself of the accuracy of the fact that the Zechstein passes up conformably into an overlying red cover. My note-books contains many additional evidences, which I have not thought it necessary to repeat.

areas in Shropshire and Staffordshire it is one great red arenaceous series, with a few subordinate courses of calcareous conglomerate. Following it to the north, Mr. Binney has demonstrated that the fossils of the Zechstein show themselves in the heart of red marls which occupy on the whole a superior part of such a red series; and in tracing these rocks northwards he has demonstrated that there are, besides, two great underlying masses, first of conglomerates and breccias, and next of soft red sandstones, the latter attaining, as he believes, a thickness of not less than 2000 feet. Here then the Permian may be considered a Trias. Professor Harkness, in a memoir he is preparing, estimates the thickness of these Lower Sandstones and conglomerates to the N.E. of West Ormside, in Cumberland, at 4000 to 5000 feet, and shows that they are surmounted by marl-slates bearing plants, thin-bedded red sandstone, grey shale, and sandstone and limestone, the latter — the representative of the Magnesian Limestone—being covered by red argillaceous shale.* Now in all these cases the Permian is a series divisible into three or more parts. But when we follow the same group into Scotland, it there parts with its calcareous feature, and, becoming one red sandstone of vast thickness, is again a *Monas*.

I have entered into this explanation because my friend Dr. Geinitz has seized upon one illustration in my work 'Siluria' which shows that in certain tracts, where the Zechstein or Magnesian Limestone is subordinate to an enveloping series of sandstones, the Permian of my classification is *there* as much a tripartite Palæozoic group as the Trias of Central Germany is a triple formation of Mesozoic age. Unless, therefore, the data to which my associates and self have appealed, in the work on 'Russia and the Ural Mountains,' and which I have further developed in Memoirs read before the Geological Society, and in my two editions of 'Siluria,' be shown to be inaccurate, I hold to the opinion that there are tracts in which the Zechstein is simply a fossiliferous zone in a great sandstone series, to which no division by numerals can be logically applied. Even if I do not appeal to the natural evidences in England, Russia, and parts of Germany, but refer to those tracts where the Zechstein or Magnesian Limestone has no natural red cover, I may well ask, does not the word "Permian," in the sense in which it was originally adopted, serve for every tract wherein the uppermost palæozoic fossil animals and plants are found, whether the strata of which the group is composed form, as in Russia and Silesia, one great series of alternations of plant-bearing sandstones and marls in parts containing bands of fossiliferous limestone, or whether, as in other tracts, the Zechstein stands alone (as near Saalfeld), or in others, again, where the group is tripartite, and even quadripartite? Quite

* The red clay or argillaceous shale which covers the limestone is surmounted at Hilton, in Cumberland, by five hundred feet of red sandstone, which, though perfectly conformable to the subjacent Permian rocks, he considers to belong to the Bunter Sandstein of the Trias. Here, then, as in Germany, the limestone may have a red cover, and yet the Bunter Sandstein be intact.

irrespective, however, of the question of whether there are or are not localities in Germany where the Zechstein passes upwards into a red rock, which forms no true part of the Bunter Sandstein of the Trias, we have only to look to the environs of Dresden, on the one hand, and to Lower Silesia on the other, to see the inapplicability of the word "Dyas" to this group.

Near the capital of Saxony, Dr. Geinitz himself pointed out to me that the Rothliegende is there divided into two very dissimilar parts; and these, if added to the limestone which is there interpolated, or to the true Zechstein of other places, constitute a Trias. Again, Beyrich, in his Map of Lower Silesia,* has divided the vast Rothliegende of those mountains into Lower and Upper, the two embracing *eight* subdivisions according to that author.

In repeating, then, that the word "Permian" was not originally proposed with the view of affixing to this natural group any number of component parts, but simply as a convenient short term to define the Uppermost Palæozoic group, I refer all geologists to the very words I used in the year 1841, when the name was first suggested. In speaking of the structure of Russia, I thus wrote:—"The Carboniferous system is surmounted to the east of the Volga by a vast series of beds of marls, schists, limestones, sandstones, and conglomerates, to which I propose to give the name of 'Permian System,' because, although this series represents *as a whole* the Lower New Red Sandstone (Rothe-todte-liegende) and the Magnesian Limestone or Zechstein, yet it cannot be classed exactly, whether by the succession of the strata or their contents, with either of the German or British subdivisions of this age."†

After pointing to the governments of Russia over which such Permian rocks ranged, I added:—"Of the fossils of this system, some undescribed species of *Producti* might seem to connect the Permian with the Carboniferous era; and other shells, together with fishes and saurians, link it more closely to the period of the Zechstein, whilst its peculiar plants appear to constitute a Flora of a type intermediate between the epochs of the New Red Sandstone or Trias and the Coal-measures. Hence it is that I have ventured to consider this series as worthy of being regarded as a system."‡

In subsequent years, having personally examined this group in the typical tracts of Germany as well as of Britain, I felt more than ever assured that, from the great local variations of mineral succession of the group, the word "Permian," which might apply to any number of mineral subdivisions, was the most comprehensive and best term which could be used, the more so as it was in harmony with the principle on which the term Silurian had been adopted.

Apart from the question of the substitution of the new word

* See also 'Siluria,' 2nd edit. p. 313.

† Phil. Mag. xix. p. 419.

‡ In my last edition of 'Siluria' I have spoken of the Permian as the uppermost Palæozoic *group*, but have not deemed it a system by comparison with the vast deposits of Carboniferous, Devonian, and Silurian age.

"Dyas" for the older name "Permian," I take this opportunity of expressing my regret that some German geologists are returning to the use of the term "Grauwacke Formation," as if years of hard labour had not been successfully bestowed in elaborating and establishing the different Palæozoic groups, all of which, even including the Lower Carboniferous deposits, were formerly confusedly grouped under the one lithological term of the "Grauwacke Formation."

Respecting as I do the labours of the German geologists who have distinguished themselves in describing the order of the strata and the fossil contents of the group under consideration, I claim no other merit on this point for my colleagues De Verneuil and Von Keyserling, and myself, than that of having propounded twenty years ago the name of "Permian" to embrace in one natural series those sub-formations for which no collective name had been adopted. Independently therefore of the reasons above given, which show the inapplicability of the word "Dyas," I trust that, in accordance with those rules of priority which guide naturalists, the word "Permian" will be maintained in geological classification.

London: Belgrave Square.
Nov. 30, 1861.

THE GEOLOGICAL AND CHRONOLOGICAL DISTRIBUTION OF THE DEVONIAN FOSSILS OF DEVON AND CORNWALL.

By W. Pengelly, F.G.S.

The limestones, slates, and associated sandstones of North and South Devon and Cornwall have, as is well known, caused much perplexity as to their real place in the chronological series of the geologist. Thanks, however, to the labours of Professor Sedgwick, Sir R. I. Murchison, Mr. Lonsdale, and others, the problem is now generally admitted to be solved; the rocks in question are the representatives or equivalents of the Old Red Sandstone of Scotland and elsewhere; they belong to what is known as the *Devonian* age of the world. Some little difficulty, however, exists—or rather once existed—in the way of the full acceptance of this chronology. The rocks of Devonshire are crowded with the remains of invertebrate animals, especially shells, corals, and sponges; whilst the supposed contemporary deposits in Scotland and the adjacent islets are so rich in fossil fish that, in the language of the late Hugh Miller, "Orkney, were the trade once opened up, could supply with ichthyolites, by the ton and the shipload, the museums of the world."* But the fossils characteristic of either of these districts are not found in the other; there are no organic links connecting the two localities.

* 'Footprints of the Creator,' p. 2.

Scotland does not yield the mollusks or zoophytes of Devonshire, nor is there recorded in the latter district more than the faintest trace of the ichthyolitic wealth of the North. Though this fact may still have difficulties connected with it, they have ceased to be chronological, for Sir R. I. Murchison tells us "that the same fossil fishes, of species well known in the middle and upper portions of the Old Red of Scotland, and which in large tracts of Russia lie alone in sandstone, are in many other places found intermixed, in the same bed, with those shells that characterize the group in its slaty and calcareous form in Devonshire, the Rhenish country, and the Boulonnais. This phenomenon, first brought to light in the work on Russia, by myself and colleagues, demonstrates more than any other the identity of deposits of this age, so different in lithological aspect, in Devonshire on the one hand, and central England and Scotland on the other. The fact of this intermixture completely puts an end to all dispute respecting the identification of the central and upper masses at least of the Old Red of Scotland with the calcareous deposits of Devonshire and the Eifel."*

In a paper "On the Slate Rocks of Devon and Cornwall," read before the Geological Society of London in 1851, Professor Sedgwick stated his views respecting the division of these rocks into three groups, as follows:—

"The first and oldest of these groups may be conveniently called the *Plymouth group*, using these words in an extended sense, so as to include all the limestones of South Devon, and the red sandstones superior to the Plymouth limestones. The equivalent to this group in North Devon includes, I think, the Ilfracombe and Linton limestones, as well as the red sandstones of the north coast.

"The second group includes the slates expanded from Dartmouth to the metamorphic group of Start Point and Bolt Head, and is, so far as I know, without fossils; it may be called the *Dartmouth group*, and its equivalent in North Devon is found in the slates of Morte Bay, which end with beds of purple and greenish sand-rock and coarse greywacke. It ranges nearly east and west across the county.

"The third group is not, I think, found in South Devon; but in North Devon it is well defined, commencing on a base line of sandstone beds, which range nearly east and west from Baggy Point (on the western coast) to Marwood (which is a few miles north of Barnstaple), and thence towards the eastern side of the county. This group is continued in ascending order to the slates on the north shore of Barnstaple Bay; but its very highest beds are seen on the south shore of the bay, dipping under the base of the culm measures.

"The equivalent of this third and highest Devonian group is found to the south of the great culm-trough, in a group, near the top of which appear the limestone-bands and fossiliferous slates of Petherwin. It may be called the *Barnstaple* or *Petherwin group*."†

* 'Siluria,' 3rd edition, p. 382.

† Quarterly Journal Geol. Soc. vol. viii. p. 3.

Professor Sedgwick, in the same paper, recognizes the Plymouth group in the slates of Looe, Polperro, and Fowey, in Cornwall.*

Accepting, at least provisionally, this chronology, we have, when considered chronologically as well as geographically, what, as a matter of convenience, may be called five fossiliferous areas; namely, a deposit of the age of the Plymouth group in each of the districts, South Devon, North Devon, and Cornwall; and one of the Barnstaple age in each of the two latter. To avoid repetition, they will be spoken of throughout this paper as *Lower South Devon*, *Lower North Devon*, *Lower Cornwall*, *Upper North Devon*, and *Upper Cornwall*. The terms "Upper" and "Lower" are to be understood as applied relatively to the rocks of Devon and Cornwall only, and not as embodying or implying any opinion respecting the co-ordination of these rocks with deposits of the Devonian age elsewhere.

Had existing materials warranted, it would have been desirable to have made a further division, namely, one having reference to the *mineral character* of the deposits, as well as to *time* and *place;* for it is certain, as might have been expected, that in the same area some fossils are peculiar to the argillaceous beds, and others are found only in the calcareous strata; thus, for example, I learn from Mr. Godwin-Austen that he has found the remarkable coral *Pleurodictyum problematicum* in the slates, but not in the limestones, at Ogwell, in South Devon. My own experience is in harmony with this. I have found specimens of the same fossil in the slates at Torquay, and hundreds of them occur in rocks of the same character at Looe, in Cornwall, but not a trace of it in limestone anywhere. The two species of sponges belonging to the genus *Steganodictyum* of Professor M'Coy occur in the slates along the entire coast of Cornwall, from Fowey Harbour to the Rame Head; at Bedruthen Steps in the north of the same county; and at Mudstone Bay, near Brixham, in South Devon; but have never been met with in calcareous strata. At present, however, it would be premature to attempt a division of this kind.

My present object is to give some account of the amount and character of the Devonian population of the five areas as above defined, when the census was last taken. The inquiry as to character goes no further than to ascertain to what extent they were a migratory or colonizing race.

Having spent a considerable portion of the leisure I have been able to command during the last twenty years in collecting and studying the fossils of the districts under consideration, especially along the entire line of coast extending from Polperro in Cornwall to Torbay in Devonshire, and also at South Petherwin, I have naturally been led to pay some attention to their distribution in time and space; and several concurring circumstances have recently brought the subjects more prominently before me. Amongst other things I may mention a passage in the recent address of Professor

* Quarterly Journal Geol. Soc. vol. viii. p. 14.

Phillips, as President of the Geological Society of London, and also one in Professor Haughton's Appendix to the 'Voyage of the Fox in the Arctic Seas.' Professor Phillips, when discussing the influence of ancient currents of the sea, remarks that "only a small proportion of the fossils of North Devon occur in South Devon;"* and Professor Haughton says, "I do not believe in the lapse of a long interval of time between the Silurian and Carboniferous deposits,—in fact in a Devonian period.

"The same blending of corals has been found in Ireland, the Bas Boulonnais, and in Devonshire, where Silurian and Carboniferous forms are of common occurrence in the same localities."†

It should be remembered that the statement with which we have here to deal is, "that the blending of Silurian and Carboniferous *corals*" (the word is not *fossils*) "is of common occurrence in Devonshire."

I have consulted such registers as I have been able to command, and have thrown so much of their contents as bear on the questions before us in the following tabular form; for which, of course, no higher value is claimed than attaches to the original documents.

The materials have been mainly derived from Professor Morris's 'Catalogue of British Fossils,' published in 1854, in which are embodied the results of the labours of Mr. Lonsdale, Professors Phillips and M'Coy, and Messrs. Edwards and Haime. The liberties taken with the 'Catalogue' have been but few; such, for example, as the removal of the Devonian *Stromatopores* from the class Zoophyta to Amorphozoa, *Sphæronites tessellatus* from Echinodermata also to Amorphozoa, and the addition of a few localities to those already registered.

I have great pleasure in acknowledging the prompt and kind assistance of Mr. Salter, of the Geological Museum, Jermyn Street, London, in certain matters on which I consulted him.

Every geologist is, of course, aware of the numerous and elaborate tables and ratios introduced by Professor Phillips in his 'Palæozoic Fossils of Devon and Cornwall,' when discussing questions akin to those under consideration. In the preparation of this paper the author has in no way made use of the valuable data these tables contain.

It appears from the three left-hand columns of figures, headed "Totals," Table I., that, taken together, the five areas have yielded three hundred and forty-seven species, belonging to ninety-seven genera and forty-nine families, of nine classes of animals; namely, three classes of the sub-kingdom Radiata, one of Articulata, and five of Mollusca; hence fifteen of the twenty-four classes into which the existing animal kingdom is commonly divided are totally unrepresented in the series, as is the entire vegetable kingdom also. It may be as well to state here that, in conformity with Morris's

* Quarterly Journal Geol. Soc. vol. xvi. p. xl.
† 'Voyage of the Fox,' Appendix No. iv. p. 387.

TABLE I.

SHOWING THE *ABSOLUTE* DISTRIBUTION IN TIME AND SPACE OF THE DEVONIAN FOSSILS OF DEVON AND CORNWALL.

Classes.	Totals.			Peculiar to					Common to										Totals.					Common to					
	Families.	Genera.	Species.	L. S. D.	L. N. D.	L. C.	U. N. D.	U. C.	L. S. D., L. N. D.	L. S. D., L. C.	L. S. D., L. N. D., L. C.	L. S. D., L. C., U. N. D.	L. S. D., U. N. D.	L. S. D., U. C.	L. S. D., U. N. D., U. C.	L. S. D., L. C., U. N. D., U. C.	L. N. D., U. N. D.	U. N. D., U. C.	L. S. D.	L. N. D.	L. C.	U. N. D.	U. C.	Eu.	Eu. Am.	Am.	Eu. Am. Au.	Silurian.	Carboniferous.
Amorphozoa	2	4	9	7	...	1	...	...	...	1	...	...	...	...	...	...	...	...	8	...	2	...	...	1	...	...	...	...	...
Zoophyta	6	20	49	40	1	1	...	...	1	2	1	...	...	2	...	1	...	...	47	3	5	1	3	18	4	1	1	3	...
Echinodermata	3	6	15	7	...	1	6	1	...	...	...	...	...	...	...	...	...	...	7	...	1	6	1	2	...	...	...	...	6
Crustacea	7	8	11	7	...	...	...	2	...	1	...	1	...	...	...	...	...	...	9	...	2	1	2	1	...	...	...	...	1
Bryozoa	3	7	11	6	...	...	2	1	1	...	...	...	...	...	...	...	...	1	7	1	...	3	2	1	...	...	...	...	6
Brachiopoda	7	16	108	58	3	3	14	7	5	1	...	...	3	4	2	...	1	6	73	9	4	26	20	20	1	...	...	2	24
Lamellibranchiata	9	17	49	15	1	...	16	12	...	...	...	...	2	1	...	...	1	2	18	2	...	21	14	7	...	...	...	2	4
Gasteropoda	9	14	47	31	...	1	6	3	...	...	...	...	...	2	1	...	...	3	34	...	1	10	9	6	...	...	...	...	10
Cephalopoda	3	5	48	20	...	...	6	18	...	...	...	...	1	2	...	...	...	1	23	...	...	8	21	5	...	...	...	1	7
	49	97	347	191	5	7	50	44	7	5	1	1	6	11	3	1	2	13	226	15	15	76	72	61	5	1	1	8	58
				297					50															68				66	
				347																									

'Catalogue,' the Heteropodous Mollusca are, in Table I., included in the class Gasteropoda.

It is scarcely necessary to remark that the fossils of Devon and Cornwall do not fully represent the organisms of the Devonian age, as seven other classes—Pisces, Pteropoda, Cirrepedia, and Annelida, amongst animals, and Cellulares, Monocotyledones, and Polycotyledones amongst plants—have been found in rocks of this age elsewhere; and of these the two first and the fifth have been met with in other British localities. The reptiles *Steganolepis* and *Telerpeton*, of the Elgin Sandstone, are not enumerated here, as some doubt attaches to the question of their chronology, if indeed they are not certainly Triassic. The single articulated class, Crustacea, is by no means rich in any way; with one exception, all its genera are Trilobites, and commonly contain but one species each. The most important class numerically is Brachiopoda, to which one hundred and eight species belong, that is, thirty-one per cent. of the entire series. The families and genera of Cephalopoda are richer in species than those of any other class, averaging sixteen for each family, and ten for each genus.

The most striking fact in this connection is the specific abundance of Brachiopoda and Cephalopoda, and the paucity of the classes Lamellibranchiata and Gasteropoda, as compared with the numerical rank of the same classes in the existing Fauna. This fact will, perhaps, be most strikingly exhibited by the following table, which has been thus computed: in the left-hand column the aggregate number of the species of fossil mollusca found in Devon and Cornwall has been put = one thousand, and the numbers belonging to each class computed to this; the right-hand column has been formed on the same principle, and is based on the data given by Forbes and Hanley in their 'History of British Mollusca.'

TABLE II.

	Devonian Mollusca of Devon and Cornwall.	Existing British Mollusca.
Bryozoa	42	72
Brachiopoda	410·5	15·5
Lamellibranchiata	186	359·5
Gasteropoda	179	521·5
Cephalopoda	182·5	31·5
	1,000	1,000

It appears, then, that within existing British seas the Lamellibranchiates are about twenty-four times more numerous specifically, than the Brachiopods, whilst within, what may be called, the same area, the latter were to the former, during the Devonian period, somewhat more than as two to one; that is, they were then fifty times more abundant than at present in comparison with the other great class of Acephala. In like manner it is seen that, relatively to the Gasteropoda, the Cephalopoda were, in this early age of our planet, seventeen times more numerous than now. It may be added that, within the district under notice, the registered species of Devonian Brachiopoda *absolutely*, and in a high ratio, exceed those belonging to the same classes within existing British seas; and the fact is the same for the world at large.

The five columns of Table I., headed "Peculiar to," and distinguished by the initials of the five areas respectively, show the number of fossil species which, so far as England is concerned, are peculiar to each; from which it appears that the fossils of Devon and Cornwall have a very limited and unequal distribution. Two hundred and ninety-seven species, that is, eighty-five per cent. of the whole, are peculiar to one or other of the areas, whilst no more than fifty species, or scarcely fifteen per cent. of the entire series, are distributed amongst them. Lower South Devon monopolizes no fewer than one hundred and ninety-one species in this way, or, in other words, fully sixty-four per cent. of the two hundred and ninety-seven, species thus limited, or fifty-five per cent. of all the known Devonians of the two counties are restricted to this single area. Lower North Devon, on the other hand, appears to be equally remarkable for its fossil poverty.

It is unnecessary to say that five areas taken two, three, four, and five together are capable of making twenty-six different combinations, namely, ten two together, ten three together, five four together, and one five together. The ten combinations, however, headed "Common to," in Table I., are all that are required to show the distribution of the fifty species not confined to one single area. Not a single species of this ancient Fauna is common to the five areas, and only one, the coral *Cyathophyllum celticum*, is found in each of four of them. The well-known coral *Favosites cervicornis* is the only fossil found in each of the three contemporary deposits of Lower South and North Devon and Cornwall. Of two areas only, Upper North Devon and Upper Cornwall have the greatest, and Lower South Devon and Lower Cornwall the least, number in common; in the former a total of seventeen, and in the latter of eight species only. Dissimilar as are the organic distributions in these two pairs of areas, they are probably just what might have been expected. In each pair the two areas are pretty closely connected geographically, and are supposed to be contemporary, as their names imply; but in the former the mineral character is much the same in each area, and we have a greater organic similarity than ordinary; in the latter the deposits are very unlike—Lower South Devon being rich in limestone as well as slate, whilst in Lower Cornwall the fossiliferous beds are all but exclusively argillaceous—and there are very few organic remains in common; a marked instance, probably, of the influence of the mineral character of the ancient sea-bottom on organic existence. Though less varied, the fossils are frequently as numerous individually in the slate as in the limestone.

It must be understood that any one of the ten columns just noticed shows, not the *total* number of species common to the areas the initials of which stand at its head, but simply the number at once common and restricted to them collectively; thus the second of these columns, headed L. S. D., L. C., shows that five species are common and restricted to Lower South Devon and Lower Cornwall, but in the third column we find one species common to them and also to Lower North Devon, in the fourth one common to them and to Upper North Devon, and in the eighth one found in each of them and also in Upper North Devon and Upper Cornwall; hence there are eight species common to the two areas instanced, five of which are restricted to them collectively, and three not. The same explanation applies to the other areas. The total number of species found in any area will be ascertained by adding the figures in all the columns marked "Peculiar to" and "Common to," at the heads of which the initials of the area are found; thus, for example, a total of forty-seven species of Zoophyta occurs in Lower South Devon, of which forty are not found elsewhere in Devon and Cornwall. Moreover, as the column marked "Species" shows that the two counties have yielded forty-nine species belonging to this class, it is evident that two of the total number have not been met with in Lower South Devon; and so on for the other classes and areas, as is shown in the five columns headed "Totals," and distinguished by the initials of the areas. Ranged according to their *peculiar* specific fossil wealth the areas stand, in descending order, thus:—Lower South Devon, Upper North Devon, Upper Cornwall, Lower Cornwall, and Lower North Devon; the order is the same when the *total* number of species found in them is considered, with the single exception that, in that case, Lower North Devon and Lower Cornwall are equal.

Of the three hundred and forty-seven species, sixty-seven are met with in various parts of continental Europe, and seven in North America; six of the latter being included in the European sixty-seven, and one of the six is also found in New South Wales; thus making a total of sixty-eight species common to Devon and Cornwall and districts beyond the British Isles.*

Comparatively few of the *Devonian* fossils of Devon and Cornwall appear to have been derived from the Silurian Fauna; eight species only—just enough to suggest a problem or two—are referable to that earlier period; namely, three Corals, two Brachiopods, two Lamellibranchiates—one from each of the sections Monomyaria and Dimyaria—and one Cephalopod. The three corals are *Favosites fibrosa*, *Emmonsia hemisphærica*, and *Chonophyllum perfoliatum*. The first has been found in Lower Silurian rocks at Landovery, in the upper

* See in Table I. the columns headed Eu. (continental Europe), Eu. Am. (Europe and America), Am. (America), Eu. Am. Au. (Europe, America, and Australia.)

deposits of the same system in various parts of the typical Silurian country, in eight counties of Ireland, in Russia, and in three North American localities. During the Devonian era it existed in several parts of Devonshire, in France, and Germany. Apparently confined to Britain during the earliest stage of its existence, it became more adapted to the world, or the world to it, during the Upper Silurian age, when it reached the maximum of its migratory powers (by no means an ordinary one), and visited many distant parts then; declining in vigour, or satiated with travel, it retired within the European borders during the Devonian period, and there received its dismissal from the stage of life. *Emmonsia hemisphærica* seems not to have begun life quite so early as its friend which we have just dismissed; its origin dates in *Upper* Silurian times, when it seems to have been confined to the area of modern America, ranging from the State of Ohio to Tennessee; having outlived the Silurian period, it sent colonies to Spain and Britain, and greatly extended its range in America. *Chonophyllum perfoliatum* differs from the two former in having always lived within narrow geographical limits; it occurs in Upper Silurian rocks at Wenlock, and in Devonian beds at Ramsley, near Newton Abbott; but its appearance elsewhere is not recorded.

The wide geographical range of the two first of these corals would seem to imply hardy plastic constitutions, fitting them for distant travel and existence under varied circumstances; there is therefore nothing surprising in their extended vertical range; the second, however, seems to have disappeared when at the very zenith of its widely extended power.

The very limited distribution in space of the last of the trio would scarcely suggest the thought that such an organism would be likely to be capable of enduring thermal and other physical changes such as, there are reasons for believing, considerable lapses of time introduce into any given area, changes probably not dissimilar to those experienced in passing to a distant locality in any one and the same period. On the other hand, the well-known fossil coral *Favosites Goldfussi* occurs in Devonian rocks in Devonshire, at Nehou and Visé in France, at Millar in Spain, in the Oural in Russia, in the States of Ohio and Kentucky in North America, and in New South Wales; it was the most decided cosmopolite of the Fauna to which it belonged, the greatest traveller of its day, the earliest *Devonian* that circumnavigated the globe, the prototype of the Drake of a later age. It seems to have successfully struggled with the varying conditions consequent upon change of place, and might have been expected to be just as capable of contending with such as depend on lapses of time; nevertheless, the facts do not harmonize with such conclusions. *Chonophyllum perfoliatum* formed part of the Silurian and Devonian Faunas, but was confined to the British area; *Favosites Goldfussi* was at home in every part of the world, yet it commenced and terminated its career within the Devonian period.

The rocks of Devon and Cornwall have fifty-eight species of fossils in common with those of the Carboniferous group, namely, six Echinoderms, one Crustacean, six Bryozoons, twenty-four Brachiopods, four Lamellibranchiates, ten Gasteropods, and seven Cephalopods, but no corals or sponges; so that it cannot be said that "there is a blending of Silurian and Carboniferous corals in Devonshire," whatever there may be elsewhere; for though, as has been stated, three Silurian corals have been found, not one referable to the Carboniferous Fauna has been met with there. This assertion is made on the authority of Messrs. Edwards and Haime, who, in their monograph on 'The British Fossil Corals from the Mountain Limestone,' state that "seventy-six species have already been found in the deposits appertaining to this geological division, and the presence of none of these corals has as yet been satisfactorily proved in beds belonging to any other period."* Again, in their monograph on 'British Devonshire Fossil Corals,' they say,—"Three of these Devonian fossils exist also in the Silurian rocks, but all the others appear to be peculiar to the Devonian period."† This was the language, in 1853, of the zoophytologists selected by the Palæontographical Society to prepare a monograph on this branch of palæontology, who were thoroughly acquainted with the literature of the subject, and who had had access to almost every public and private museum and collection in the United Kingdom.

The fifty-eight species which passed from the Devonian to the Carboniferous period are found in the three principal fossiliferous deposits of Devon and Cornwall, as exhibited in the following table:—

TABLE III.

	Totals.	L. S. D.	U. N. D.	U. C.
Echinodermata	6	3	2	1
Crustacea	1	1	...	...
Bryozoa	6	3	2	2
Brachiopoda	24	15	8	7
Lamellibranchiata	4	2	...	2
Gasteropoda	10	6	3	3
Cephalopoda	7	4	2	3
	58	34	17	18

It is, perhaps, worthy of remark that the five areas have a smaller number of organic forms in common with one another—closely connected as they are both in space and time—than they have, as a whole, with Devonian deposits in continental Europe and elsewhere beyond the British Isles, or with the Carboniferous rocks of Ireland and central and northern England.

* Monograph of British Fossil Corals,' by Messrs. Edwards and Haime, p. 150.
† Ibid. p. 212.

Table I., to which attention has so frequently been directed, represents, so far as is at present known, the *absolute* distribution of the fossils in the two counties in which they occur; but, for purposes of geological chronology, it is probably of greater importance to ascertain their *relative* distribution, which may differ widely from that shown by the figures, since the various classes of animals represented in the fossil series were not equally rich in species, and perhaps differed much in, what may be called, their distributivity.

The *relative* distribution is exhibited in Table IV., which has been calculated from the data contained in Table I., thus: the total number of species in each class is put = 1000, and the figures in the other columns equated to this.

Ranged in descending order, according to their relative specific prevalence in each era, the classes stand thus:*—

Lower South Devon: Zoophyta, Amorphozoa, Crustacea, Gasteropoda, Brachiopoda, Bryozoa, Cephalopoda, Echinodermata, and Lamellibranchiata.

Lower North Devon: Bryozoa, Brachiopoda, Zoophyta, and Lamellibranchiata.

Lower Cornwall: Amorphozoa, Crustacea, Zoophyta, Echinodermata, Brachiopoda, and Gasteropoda.

Upper North Devon: Lamellibranchiata, Echinodermata, Bryozoa, Brachiopoda, Gasteropoda, Cephaloda, Crustacea, and Zoophyta.

Upper Cornwall: Cephalopoda, Lamellibranchiata, Gasteropoda, Brachiopoda, Bryozoa, Crustacea, Echinodermata, and Zoophyta.

Both relatively and absolutely each class has its maximum specific development in South Devon, with the exception of Lamellibranchiata only, which has its greatest specific variety in Upper North Devon.†

South Devon is the only area in which each of the nine classes occurs; Lower Cornwall and Lower North Devon are each poor in classes as well as species, the latter yielding representatives of four classes only.

When ranged in descending order, so as to show, relatively, the transmission of species from the Devonian to the Carboniferous era, the classes stand thus:—Bryozoa, Echinodermata, Brachiopoda, Gasteropoda, Cephalopoda, Crustacea, and Lamellibranchiata. And when similarly arranged for the species derived from the Silurian Fauna, they take the following order:—Zoophyta, Lamellibranchiata, Cephalopoda, and Brachiopoda.

The class Amorphozoa is the only one in the Devonian Fauna which does not contain either Silurian or Carboniferous species.‡

From Table IV. it appears that fifty-six genera are peculiar to one or other of the three areas Lower South Devon, Upper North Devon, and Upper Cornwall; and that, of these, forty-six, or very nearly one-half the total ninety-seven, are restricted to Lower South Devon. No genus is confined to Lower North Devon or Lower Cornwall.

* See in Table IV. the columns headed "Totals."

‡ See in Tables I. and IV. the columns headed "Totals."

† See in Table IV. the columns headed "Silurian" and "Carboniferous."

TABLE IV.

SHOWING THE *RELATIVE* DISTRIBUTION, IN TIME AND SPACE, OF THE DEVONIAN FOSSILS OF DEVON AND CORNWALL.

Classes.	Peculiar to					Common to										Totals.					Common to					
	L. S. D.	L. N. D.	L. C.	U. N. D.	U. C.	L. S. D., L. N. D.	L. S. D., L. C.	L. S. D., L. N. D., L. C.	L. S. D., L. C., U. N. D.	L. S. D., U. N. D.	L. S. D., U. C.	L. S. D., U. N. D., U. C.	L. S. D., L. C., U. N. D., U. C.	L. N. D., U. N. D.	U. N. D., U. C.	L. S. D.	L. N. D.	L. C.	U. N. D.	U. C.	Eu.	Eu. Am.	Am.	En. Am. Au.	Silurian.	Carboniferous.
Amorphozoa	778	...	111	...	...	...	111	...	...	...	...	...	...	...	...	889	...	222	...	...	111	...	...	...	...	...
Zoophyta	816	20	20	...	...	20	41	20	...	...	41	...	20	...	...	960	61	102	20	61	367	82	20	20	61	...
Echinodermata	467	...	67	400	67	...	...	...	...	...	...	...	...	...	...	467	...	67	400	67	133	...	...	...	...	400
Crustacea	636	...	...	...	182	...	91	...	91	...	...	...	...	...	...	818	...	182	91	182	91	...	...	...	...	91
Bryozoa	545	...	...	182	91	91	...	...	...	...	...	...	...	...	91	636	91	...	273	182	91	...	...	...	...	545
Brachiopoda	537	28	28	130	65	46	9	...	...	28	37	19	...	9	56	676	83	37	241	185	185	9	...	...	19	222
Lamellibranchiata	306	20	...	327	245	...	...	...	...	41	20	...	...	20	41	367	41	...	429	286	143	...	...	...	41	82
Gasteropoda	660	...	21	128	64	...	...	...	...	...	43	21	...	...	64	723	...	21	213	191	128	...	...	...	...	213
Cephalopoda	417	...	...	125	375	...	...	...	...	21	42	...	...	...	21	479	...	...	167	438	104	...	...	...	21	146

The fifty-six genera thus limited are generally poor in species, the aggregate number belonging to them being no more than ninety-two; that is, fifty-eight per cent. of all the genera contain no more than twenty-six per cent. of the total number of species. Forty-one of these fifty-six genera contain each but a single species in the British Devonian deposits. The only genera thus limited that can be said to be rich in species are *Stromatopora*, *Acervularia*, and *Clymenia*. The first, a genus of Amorphozoons, contains five species, all limited to South Devon; the second, a group of corals belonging to the great Palæozoic family *Cyathophyllidæ*, contains five species, all peculiar to South Devon; and the last, a genus of Cephalopod mollusks belonging to the family *Nautilidæ*, contains eleven species, all found at South Petherwin, not one being met with elsewhere in Britain. With the single exception of *Cyrtoceras rusticum*, found at South Petherwin—and this probably a synonym for *Orthoceras arcuatum*—the genus *Cyrtoceras* is restricted to South Devon, where it is represented by twelve species.

The distribution of the ninety-seven genera of fossils found in the two counties is exhibited in the following table:—

TABLE V.

	Total. Genera.	Peculiar to					Totals.				
		L. S. D.	L. N. D.	L. C.	U. N. D.	U. C.	L. S. D.	L. N. D.	L. C.	U. N. D.	U. C.
Amorphozoa	4	3	...	...	...	...	4	...	1	..	...
Zoophyta	20	14	...	...	...	...	20	1	4	1	3
Echinodermata	6	2	...	...	3	...	3	...	1	4	1
Crustacea	8	6	...	...	...	1	7	...	1	1	2
Bryozoa.	7	3	...	...	1	...	5	1	...	3	2
Brachiopoda	16	6	...	...	...	...	16	4	1	8	7
Lamellibranchiata	17	5	...	...	3	1	11	2	...	8	7
Gasteropoda	14	7	...	...	...	...	13	...	...	7	6
Cephalopoda	5	...	...	...	...	1	4	...	...	2	5
	97	46	...	...	7	3	83	8	8	34	33
		56					41				
		97									

Every genus of the classes Amorphozoa, Zoophyta, and Brachiopoda occurs in South Devon, and with the exception of Cephalopoda it contains a greater number of genera in each class than either of the other areas. All the genera of Cephalopoda appear at South Petherwin:

The genera found in the two counties were not all confined to the Devonian period. The following table shows their *Chronological* distribution so far as the Silurian, Devonian, and Carboniferous deposits of Britain are concerned.

TABLE VI.

	Total Devonian Genera.	Peculiar to Devonian.	Common to		
			Devonian and Silurian.	Carboniferous, Devonian, and Silurian.	Carboniferous and Devonian.
Amorphozoa	4	3	1	...	...
Zoophyta	20	10	5	3	2
Echinodermata	6	2	...	3	1
Crustacea	8	1	5	...	2
Bryozoa	7	...	...	5	2
Brachiopoda	16	3	2	8	3
Lamellibranchiata ...	17	2	1	9	5
Gasteropoda	14	2	...	11	1
Cephalopoda	5	1	...	2	2
Totals	97	24	14	41	18

From which it appears that twenty-four genera,—about one-fourth of the whole series,—are peculiar to Devonian deposits, fourteen common and restricted to the Silurian and Devonian, forty-one common to all three, and eighteen common and restricted to the Devonian and Carboniferous; hence a total of fifty-five Devonian genera occur in the preceding, and fifty-nine in the succeeding period. Some of the genera occur in Neozoic deposits, and a few in the existing Fauna.

When the numbers of species contained in each of the forty-one genera of the fourth column (Table VI.) are tabulated in parallel columns for the three periods, the figures present themselves in four different principal forms of succession, as may be illustrated by taking the genera *Favosites*, *Cyathophyllum*, *Loxonema*, and *Orthoceras*.

	Sil.	Dev.	Carb.	
Favosites	8	5	1	a descending-descending series.
Cyathophyllum	9	14	8	ascending-descending.
Loxonema	2	8	14	ascending-ascending.
Orthoceras	55	12	35	descending-ascending.

The first kind shows that the maximum specific development occurs in the Silurian era, the second in the Devonian, and the third in the Carboniferous; the fourth kind may perhaps be regarded as a sort of irregularity, possibly arising from the imperfection of the geological record. There are eighteen instances of this in the series.

There is a fifth form of successional order which may be illustrated by the figures connected with the genus *Alveolites*, which stand thus:—Sil. 4, Dev. 4, and Carb. 2, thus giving no maximum in any one period. There are three instances of this.

The genera of the Devonian period are, as a whole, comparatively poor in species, and but few of those common to it and either the Carboniferous or Silurian, or both, have their maximum specific development during Devonian times.

The following table exhibits, generally, the prominent facts of the kind just specified.

TABLE VII.

Genera.	Totals.	Species in			$\frac{\text{Species.}}{\text{Genera.}}$			Maximum Specific Development in		
		Sil.	Dev.	Car.	Sil.	Dev.	Car.	Sil.	Dev.	Car.
Peculiar to Devonian......	24	...	45	...	...	2	...	...	...	...
Common to,—										
Silurian and Devonian .	14	56	30	...	4	2	...	9	2	...
Silur., Dev., and Carb.	41	386	223	510	9·4	5·4	12·4	13	2	23
Devonian and Carb. ...	18	...	49	271	...	2·7	15	...	2	12
Totals...............	97	442	347	781	8	3·6	13	22	6	35

The "Totals" in the left-hand column are the same as in Table VI. The three columns headed "Species in" show the aggregate number of species found in each period belonging to the total number of genera on the same horizontal line in the column of "Totals;" thus three hundred and eighty-six species have been found in British Silurian rocks, two hundred and twenty-three in Devonian, and five hundred and ten in Carboniferous belonging to the forty-one genera common to the three periods, and so on. The three columns headed "Species÷Genera" show the average number of species per genus in each period and division, and are obtained by dividing the total number of species by the total number of genera in each (fractions being omitted except when considerable); thus the averages in the case of the forty-one genera common to the three periods are 9·4 Silurian, 5·4 Devonian, and 12·4 Carboniferous. The total averages at the bottom of these three columns are obtained thus:—Of the ninety-seven Devonian genera, fifty-five (= 14 + 41) are found in Silurian beds, and these have yielded an aggregate of four hundred and forty-two (= 56 + 386) species, giving an average of eight per genus, and so on for the other periods. The right-hand three columns show the number of genera, which in the various divisions have their maximum specific development in each period; for example, of the forty-one genera common to the three periods, thirteen had their greatest number of species in Silurian, two in Devonian, and twenty-three in Carboniferous times; thus giving a total of thirty-eight, and, consequently, leaving three genera which had not a maximum specific development in any *one* period.

It appears, then, that the genera found in the Devonian era, as represented in Devon and Cornwall, even when those peculiar to it are included, yield a less aggregate number of species, that the average number of species per genus is smaller, and that the genera having their maximum specific development are fewer in Devonian than in either Silurian or Carboniferous times, and that in each of these particulars the Carboniferous surpasses the Silurian age.

Such appear to be the prominent facts in connexion with the subject immediately before us. What is their interpretation? This is a problem more easily proposed than solved. Are we to believe that our knowledge of the geological record is too imperfect to warrant any important generalizations? Do our museums fully represent the fossilized remains of bygone forms of life? Are all the extinct organisms which have been exhumed registered in the published lists? Is the record itself, inscribed on rocky tablets, so incomplete as to be altogether incapable of revealing to us the physical and organic history of our planet? Are the notions of biologists respecting specific distinctions, whatever they may be, sufficiently mature and uniform to warrant our relying on them? Something must doubtless be conceded on each of these points, but still there cannot but be a large outstanding quantity of fact incapable of being thus explained away. The problem demands some other solution.

Suppose it true that in some cases the organic dissimilarity which has been described was due to a difference in the mineral character of the ancient sea-bottom, such as was mentioned in the case of Lower South Devon and Lower Cornwall; still, when we have two areas, like Lower South and Lower North Devon, consisting of contemporary, almost contiguous, and scarcely dissimilar deposits, one rich and the other poor in the variety of its organic remains, having together two hundred and four species with no more than eight in common, some other solution is obviously required. Was there a terrestrial barrier separating the two areas? Was the central district occupied by dry land, stretching far both east and west, while the waves of the *Devonian* ocean rolled over the north and south of the county? for it need not be stated that the deposits we are considering are eminently marine. It may be too much to answer this question with an unqualified negative; it is easier to determine, at least, some of the ancient oceanic areas than to say where lay the contemporary continents and islands. Nevertheless, the rocks now separating the areas in question, namely, the granites, the carboniferous beds, and the red conglomerates (or, more correctly, breccias), are unquestionably more modern than those now under notice; nor is the structure of the latter such as to imply the immediate proximity of dry land in that quarter.

Besides, eight species actually did migrate from one area to the other—eight proofs, then, that a passage did exist, unless we suppose that both areas were tenanted from some more distant centre or centres of organic dispersion. It may be asked, were not these eight remnants of an older—a Silurian—fauna, forms of life whose localization had been determined by still earlier conditions? Eight Silurian forms do make their appearance amongst the fossils of Devon and Cornwall—are not these the very organisms? Now it so happens that they are not. The Silurians spoken of are *Favosites fibrosa*, *Emmonsia hemisphærica*, *Chonophyllum perfoliatum*, *Atrypa aspera*, *A. reticulatus*, *Pterinea ventricosa*, *Clidophorus ovatus*, and *Orthoceras imbricatum;* whilst the species common to Lower North and South Devon are *Favosites cervicornis*, *F. dubia*, *Fenestella arthritica*, *Stringocephalus Burtini*, *Spirifer aperturatus*, *Sp. lævicosta*, *Orthis granulosa*, and *Chonetes sordida*. In fact, there is not one Silurian form recorded amongst the Lower North Devon series. This solution, therefore, does not seem available. Shall we hold with Professor Phillips that "this unequal diffusion of definite forms of life may often be ascribed to oceanic currents"?* I cannot but think that fewer difficulties attach to this than to any other hypothesis which has been proposed; it simply requires us to suppose that a persistent oceanic stream, flowing through central Devon, separated the contemporary deposits of the north and south, and, by its thermal or other qualities, formed an all but impenetrable barrier to the marine tribes. Moreover, whilst it would account for the limited organic distribution we are considering, it would not be out of keeping with the facts that a comparatively great number of species were common to continental Europe and Devon and Cornwall; that of the fifty-eight species which passed over to the next succeeding Fauna, one only occurs in the carboniferous shales of North Devon, whilst all the others are found in central and northern England, Ireland, Belgium, Russia, and other distant localities; and that a comparatively great number of forms are common to the upper areas of Cornwall and North Devon.

Though, as we have seen, the test entirely fails, at least so far as Devonshire is concerned, on which scepticism respecting the existence of a Devonian period has been founded, namely, "that the blending of Silurian and Carboniferous corals is of common occurrence," yet if the word "fossil" is substituted for "coral," a blending of the kind certainly does occur, and doubtless the fact is not without a meaning. Eight species from the preceding period, and fifty-eight from the succeeding—a total of sixty-six—meet in Devon and Cornwall. Are they so many proofs that the rocks in which they were inhumed are not Devonian? It must be borne in mind that there are two hundred and eighty-one species that are neither Silurian nor Carboniferous, but of an intermediate character. The palæontological argument, then, stands thus:—There are sixty-six witnesses supposed to testify that the rocks are not Devonian, and two hundred and eighty-one—upwards of 4 to 1—which emphatically declare that

* Quart. Journ. Geol. Soc. vol. xvi. p. xl.

they are. But the adverse witnesses are by no means agreed amongst themselves; eight of them claim the rocks for the Silurian age, and fifty-eight for the Carboniferous. Is there no way of silencing, and yet satisfying, these doubtful characters? No method of so interpreting their testimony but that of sacrificing the Devonian system altogether? Are they not so many arguments in favour of the gradual passage of system into system? So many difficulties in the way of a belief in catastrophes, by which I mean convulsion or other form of violence (call it what you please) which, from time to time, shook the very life out of the world, causing a series of universal and synchronous depopulations of our planet? May we not regard them as so many tints intermediate, both in place and quality, between the extreme bands of the rainbow, uniting them into one beautifully graduated chromatic spectrum, so softly blending as to render it impossible to define the exact place of lines of demarcation, which, perhaps, have not, and never would have been supposed to have, an existence, had not observers hastily generalized from the imperfect evidence obtained during a period of colour blindness?

May we not regard them as just sixty-six pages in the old parish register connecting three otherwise unconnected portions, and showing that the population was not, during their time, cut off sharply, universally, and at once, whether by pestilence, war, or famine; but that the old inhabitants *gradually* disappeared, and that many of them remained amongst the new comers, discharging their accustomed functions under the somewhat changed conditions?

But if the Devonshire rocks were handed over to the Carboniferous or Silurian system, or divided between them, we should not be quit of the doctrine that some of the forms of one period have, at least in some instances, lived through it into the next; for the opponents of a Devonian period not only admit, but rest their case on the alleged fact that Silurian and Carboniferous forms are found blended together in Devonshire and elsewhere.

When, nearly a quarter of a century ago, Mr. Lonsdale first suggested that the fossils of South Devon, taken as a whole, exhibited a peculiar character intermediate to those of the Silurian and Carboniferous groups, he was perfectly aware that amongst them were forms referable to each of these Faunas; yet he made the suggestion, notwithstanding the existence of a physical objection, subsequently removed by Professor Sedgwick and Sir R. I. Murchison, who discovered that the culmiferous or anthracite shales of North Devon (superposed on the rocks we have been considering) "belonged to the coal, and not, as preceding observers had imagined, to the transition (Silurian) period."*

And what has been the effect of the progress of discovery and nicer discrimination on this point? Has it increased or decreased the evidence in favour of a Devonian period? In 1846, Sir H. De la Beche, discussing this question, gave a total of a hundred and ninety species noticed in South Devon, which he thus disposed of: seventy-

* Lyell's 'Manual,' 5th edition, p. 424.

five Carboniferous forms, ten Silurian, eight common to Silurian and Carboniferous, and ninety-seven—slightly more than half—peculiar to Devonshire.* At present (confining ourselves also to South Devon) the catalogue gives a total of two hundred and twenty-six, of which thirty-four are Carboniferous, six Silurian, and a hundred and eighty-six peculiar to the district; or putting the totals at each period = 1000, and equating the other numbers to this, the figures stand as in the following table, and show a decided advance Devonian-ward.

TABLE VIII.

	1846.	1860.
Silurian	53	26·5
Carboniferous	395	150·5
Silurian and Carboniferous	42	0·0
Peculiar	510	823·0
	1000	1000

Doubtless the fact that the Carboniferous forms so greatly outnumber the Silurian has a meaning. Does not this greater organic affinity betoken a closer connection with the more modern than with the more ancient period? Is it not an intimation that the lowest beds of Devonshire do not constitute the basement of the Devonian system?—that the county has an ample development of Upper and Middle, but not of Lower Devonian rocks?

Hitherto we have accepted the opinion of Professor Sedgwick respecting the Petherwin and Barnstaple beds; namely, that they are strictly contemporary, and constitute the uppermost division of the Devonian system. It may, perhaps, be well, before closing this paper, to go somewhat fully into the arithmetic of the question.

A glance at Table IX. will show the number of fossil species and genera found in the two areas.

TABLE IX.

	Petherwin.		Barnstaple.	
	Gen.	Spec.	Gen.	Spec.
Zoophyta	3	3	1	1
Echinodermata	1	1	4	6
Crustacea	2	2	1	1
Bryozoa	2	2	3	3
Brachiopoda	7	20	8	26
Lamellibranchiata	7	14	8	21
Gasteropoda	6	9	7	10
Cephalopoda	5	21	2	8
Totals	33	72	34	76

* Memoirs Geol. Survey, vol. i. p. 96.

Petherwin appears to have been richer than Barnstaple in Zoophyta and Cephalopoda, but poorer in Echinodermata and Lamellibranchiata; whilst neither of the areas has yielded any fossil sponges.

Assuming the higher antiquity of the South Devon and contemporary beds—to which, probably, no geologist will object—it follows that the fossils common to it and Petherwin, or Barnstaple, or both, were contributions from it to them. Regarded thus, the populations of the two areas were made up as is shown below.

TABLE X.

	Petherwin.	Barnstaple.
Silurian	Sp. 1	Sp. 1
Lower Devonian	„ 15	„ 13
New (peculiar)	„ 44	„ 50
New (common)	„ 12	„ 12
Carboniferous	„ 13	„ 16

The term "peculiar," in the table, is meant to denote such species as, in England, are found in Petherwin or Barnstaple only; and "common" to mark those found in both, but not elsewhere in the British Isles; "carboniferous" is used to designate the species common to the deposits of that age and Petherwin, or Barnstaple, or both; exclusive of six found also in Lower Devonian deposits. It may be remarked here that no fossil occurring in South Devon, Petherwin *and* Barnstaple, appears to have been found in Carboniferous rocks.

The Carboniferous figures 13 and 16 in Table X. are not in addition to the previous numbers in the Table; the totals—72 and 76 respectively—are, of course, complete without them.

In order to show the *relative* value of the figures just given, the following Table has been calculated on the method of putting each total 72 and 76 equal to 1000, and equating the other figures in Table X. to it. It should be remembered, however, that whilst this furnishes better data for comparison, it considerably magnifies the facts.

TABLE XI.

	Petherwin.	Barnstaple.
Silurian	Sp. 14	Sp. 13
Lower Devonian	„ 208	„ 171
New (peculiar)	„ 611	„ 658
New (common)	„ 167	„ 158
Carboniferous	„ 181	„ 211

The Silurian figures are, of course, quite valueless further than as showing the very slender organic connection between the deposits under notice and those of the Silurian age. A glance at the Table shows that, of the two, Petherwin is the nearest to the Lower Devonian horizon, and the most remote from the Carboniferous; true, the majority in each case is but small—208 to 171, and 211 to 181—but it must be remembered that great ones were not expected; and that, feeble as they are individually, there is strength in the fact that their testimonies agree; if they mean anything, it is that the Barnstaple beds are somewhat more modern than those of Petherwin; a conclusion to which more than one eminent geologist has been led by other, and, perhaps, more reliable evidence.

The fossils of the two areas belong to forty-six genera, of which thirty-three are represented by the Petherwin, and thirty-four by the Barnstaple series, twenty-one are common to both; hence twelve are peculiar to Petherwin, and thirteen to Barnstaple. The South Devon and contemporary beds contain sixty-four genera, of which thirteen only occur in the deposits now under notice.

Taken as a whole, the forty-six genera above mentioned have a Carboniferous, rather than a Silurian, or even a Lower Devonian *facies*. They may be divided into groups, namely, 1st, those characterized by a considerable maximum specific variety or development in some *one* period before or after Petherwin and Barnstaple times, that is, during the Silurian or Lower Devonian eras on the one side, or the Carboniferous on the other; 2nd, those that are not thus distinguished. For example, the rich genus *Orthoceras* had, in Britain, an almost equal number of species in Carboniferous and Upper Silurian times, when it was richest; hence it had no *one* period of maximum specific variety, and consequently belongs to the second of the groups just defined; as, of course, do also all other genera similarly characterized, as well as those, such as *Hallia*, which seems never to have had more than a very few species at any one time.

The first of these groups—which alone we have to consider here—contains thirty-one genera, of which six may be said to belong to the *Past*, and twenty-five to the *Future*, the age of Petherwin and Barnstaple being the chronological stand-point.

The first, or "Past" division, does not contain a number sufficiently great to be of service in this inquiry. The last, or "Future," consists of two series, namely, 1st, those genera which are equally represented in the two sets of beds; and 2ndly, those that are not; evidently the last series alone can supply information on the question under consideration. It is made up of the fifteen genera named in the following table, in which the columns headed P., B., C., exhibit the number of species, belonging to each genus, which occur in the Petherwin, Barnstaple, and British Carboniferous beds respectively.

From the table we learn that nine of these genera are found in Barnstaple only, or are more largely represented there than in Petherwin; and that nineteen species represent the ten genera found in the former area, and no more than ten the six genera of the latter. Hence, the genera tell us what the species had told us before, that the Barnstaple beds are somewhat more modern than those of Petherwin.

TABLE XII.

GENERA.	P.	B.	C.
Amplexus	1	...	5
Cyathocrinus	1	3	10
Pentremites	...	1	11
Glauconome	...	1	5
Fenestella	1	...	19
Chonetes	...	2	16
Productus	1	3	48
Modiola	1	...	16
Axinus	1	...	9
Cypricardia	...	1	9
Nucula	...	4	14
Sanguinolites	...	2	15
Loxonema	3	1	14
Macrocheilus	...	1	16
Nautilus	1	...	40
	10	19	247

We are prepared, by even a slight acquaintance with the geographical distribution of existing organisms, to find that deposits strictly contemporary, lithologically similar, and closely connected geographically, have certain fossils peculiar to each; but, unless we recognize time as a factor, it will be difficult to explain the following striking results in Petherwin and Barnstaple. Together they have yielded as many as one hundred and thirty-one species of fossils, yet have no more than seventeen in common; the fossils belong to forty-six genera, of which twenty-five are confined to one or other of the two areas, having amongst them the rich genus *Clymenia*, with its eleven species all closely restricted, in Britain, to Petherwin, yet occurring in continental Europe. The remaining twenty-one genera are represented by eighty-six species, but the representatives are rarely identical in the two areas, the peculiar being to the common as 69 to 17, that is, as 4 to 1. Contend that these beds are strictly contemporary, and the facts remain to puzzle; grant but the lapse of time, and, at least, part of the difficulty disappears, and thereby furnishes another argument in favour of the opinion now advocated.

Returning for a moment to Tables X. and XI., it will be seen that the Barnstaple have a smaller number of fossils in common with the Lower Devonian, and even the Petherwin beds, than with the Carboniferous; hence they may be considered as belonging rather to the last than to the Devonian series, or, possibly, may have to be regarded as "passage beds" between them.

ON SOME POINTS IN THE STRUCTURE OF THE SKULL OF FOSSIL MUSK-DEER (*Cainotherium*).

By Charles Carter Blake, Esq.

While examining lately the magnificent collection of fossil musk-deer, from Auvergne, in the collection of the British Museum, in the case devoted to the specimens collected by M. Bravard from the lacustrine calcareous marls of Puy-de-Dôme, a singular anomaly in the structure of the crania of the genus *Cainotherium* met my view. All the writers who have described the osteology of the skull of Ruminants have noticed those singular deficiencies or *lacunæ* which exist at the points of junction of the various bones, and which have been variously described as "lacrymal openings"* or "facial interspaces."† Their function has been unknown, and their presence, although constant in each individual species, is variable in species nearly allied to each other. In the *Cainotherium commune*, Bravard (*Microtherium Renggeri*), nearest allied to the *Hyomoschus* of the present day, ossification at this lacrymal point of intersection has extended to a much less degree than in its living analogue. The interspace in *Cainotherium* is longer in proportion to its breadth than the existing musk-deer (*Moschus chrysogaster*). In the *Dorcatherium Naui*, Kaup., on the contrary, not the slightest interspace is exhibited, and the lacrymal angle is definitively closed. In some of the specimens named *Cainotherium* in the British Museum, no interspace exists. These probably belong to a separate species,‡ as De Blainville remarks on the typical *Cainotherium commune*, termed by him *Anoplotherium laticurvatum*, that it possesses "*des lacunes sous-lacrymales assez grandes, en forme de longues virgules.*"

It is most interesting to observe a similar anomalous diversity of structure exists in the recent species of ruminants most nearly allied to the Moschidæ and Microtheria.

I need only call attention to the fact that a large lacrymal opening is present in the Llama (*Auchenia Llama*), and none in the Vicuña (*A. Vicuna*); that in the yellow-bellied musk (*Moschus chrysogaster*) a large, and in the small water-musk of Western Africa (*Hyomoschus aquaticus*) a small interspace exists; whilst in the nearly allied *Meminna Indica*, *Tragulus Stanleyanus*, and *T. pygmæus*, ossification has extended over the whole point of junction of the lacrymal (73), frontal (11), nasal (15), maxillary (21), and premaxillary (22) bones.

The object of my present communication is to point out some of the reasons for this singular anomalous structure in the fossil and recent Moschidæ.

* Gray, 'Catalogue of Mammalia' in collection of British Museum, part 3.

† Spencer Cobbold, "Ruminantia," in Todd's, 'Cyclopædia of Anatomy and Physiology,' p. 513.

‡ De Blainville, "Ostéographie," Anoplotherium, p. 75.

The functional interpretation of this singular diversity of organization in animals otherwise so nearly allied to each other, may not be manifestly apparent to the philosophical zoologist. It was satisfactorily ascertained in the year 1836 * by the observations of Messrs. Bennett, Owen, Ogilby, and Hodgson, that the suborbital sinus subserved a purpose connected with the generative functions, being dilated and swollen at certain periods of the year. But the connection of the development of the glandular structure of the carneous lacrymal sinus with the degree of ossification to which the cheek-bones extend is not obvious. If however we suppose that the large periodical swelling which, according to Mr. Hodgson, forms a huge lump of flesh bigger than, and like in shape to, the yolk of an egg, increases periodically in its dimensions, its backward pressure towards the cheek-bone would be seriously impeded by a bony wall, such as we find in the *Tragulus pygmæus* or the *Auchenia Vicuna*. The aponeurotic *fascia* which fills the lacrymal interspace in the *Hyomoschus aquaticus*, or the *Auchenia Huanaca*, would, however, yield more easily, and thus those species would in certain seasons have a greater development of their suborbital sinuses.

Mr. Ogilby† laid down the theory "as a general remark, which however he stated was not universal, that in intertropical animals the lacrymal sinus is larger than in more northern species, and in those whose range is limited to mountainous districts." This incomplete induction may be considered partially corroborated by the osteology of the Llamas. In the three varieties, Guanaco, Llama, and Alpaca, a more or less large "sublacrymal lacuna" is left. In the Vicuña, ossification has extended to such a degree as to close this completely up. How does this singular fact bear upon the theory that there is a relation between the gregarious habits of those antelopes and musk-deer which frequent the plains, and the presence of the lacrymal sinuses, and consequent non-ossification of the cheek-bones? The species of *Auchenia* which has no lacuna, is confined to the most elevated table-lands of Bolivia and Northern Chile. The three varieties in which large lacunæ are exhibited, are found over the whole Andian range, the Guanaco supporting life alike under the tropical sky of New Granada, or the frozen steppes of Patagonia. In this species we find a large development of the lacrymal interspace. But both the Guanaco and Vicuña are gregarious. It is therefore quite clear that the development of the lacrymal sinus, or the degree to which the lacrymal and other cheek-bones are ossified, have no reference whatever to the gregarious or solitary habits of the species. This was sufficiently proved by the table which was submitted by Professor Owen to the Zoological Society (Proceedings, 1836, p. 36), in which it was conclusively shown that no constancy or correlation existed with respect to the presence or absence of the suborbital sinuses. And the facial interspace seems an equally in-

* Proc. Zool. Soc. 1836, p. 34.

† Proc. Zool. Soc. 1836, p. 38.

constant character in the antelopes, as differentiating various subgenera or natural groups.

If any philosophical thinker can explain what is the *vera causa* which has provided for the Cainotherium and Guanaco deep preorbital interspaces, whilst in their congeners the Dorcatherium and Vicuña, no such interspace exists, a character originally pointed out by Dr. J. E. Gray, and which according to my experience is the sole specific difference which can be demonstrated, such explanation will be of great benefit to zoological science. The above observations are made solely with a view of suggesting further inquiry on this most interesting topic. I trust that some of those writers who have so carefully studied the osteology of Ruminantia, may be led to reconsider the question, and to make further observations on the function of the facial interspaces in both recent and fossil ruminants.

It has been suggested to me, that the two holes in the *Microtherium* skull, as they are undoubtedly asymmetrical, might have been produced artificially or accidentally, the bone at this place being exceedingly thin. Should such a theory be proved correct, the *Microtherium* of the Auvergne deposit would still find its nearest analogue in the existing Meminna of Ceylon, and by the demonstration of this affinity, still further corroborate the truth of Professor Owen's generalization,—"The affinity of the Microtheres to the Cheorotains is nevertheless very close" (Palæontology, 2nd ed. p. 372).

ON THE DISCOVERY OF HUMAN AND ANIMAL BONES IN HEATHERY BURN CAVE, NEAR STANHOPE.

By John Elliott, Esq.

In a tolerably deep ravine, surrounded by trees and brushwood growing in wild profusion, was, until lately, a cave, in that member of the carboniferous formation locally called the "Great Limestone," and situated about one mile and a quarter north from the town of Stanhope, in the county of Durham. The limestone is now being worked for the purpose of supplying the Weardale Iron Company with a flux used in the operation of smelting their ironstone; and consequently the cave has been laid bare to the light of day.

The cave was much visited a few years ago, both by strangers and persons living in the locality, but probably few of the visitors ever studied the excavating forces by means of which the cave was hollowed out of the solid limestone, and fewer still, if any, would think that they were treading on a primeval burial-place.

Doubtless the excavation must be mainly due to aqueous agency, but a reference to Sir Charles Lyell's 'Principles of Geology,' Professor Phillips's 'Treatise on Geology,' and Richardson's 'Geology,' shows that our leading writers on this subject consider that the *first* cause of a cavern must have been a fracture in the limestone rock, consequent on the upheaval of the strata, and that water then finding access to the crack, would wear it out to its present dimensions.

Fractures in this case would most probably take place when the "Red Vein" was formed, which is only between two hundred and three hundred yards distant from the cave, and crosses the ravine nearly at right-angles. This vein, which contains lead-ore, iron-stone, etc., is a wide one, requiring a wide fissure, and the force necessary to produce such a fissure would be sufficient to cause rents and small dislocations in the rocks at considerable distances. Besides this there are two other veins crossing the ravine at lesser distances from the cave, and these would still further increase the probability of an original fissure.

North. Stanhope Burn. South.

Fig. 1.—Ground plan of cavern district.

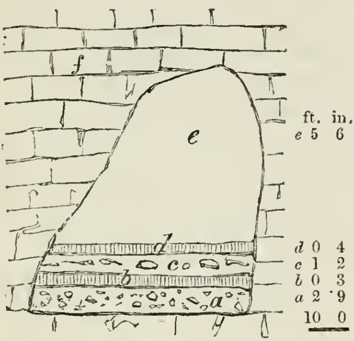
a Mouth of Cave. *b* Bone Deposit. *c* Red Vein. *d* Where the water issues from the cave. *e e* Trees and brushwood before the quarry was worked, on hill-side; angle of slope 45 degrees.

The cave must be very old if we suppose it to have been formed by the water running down the ravine when on a level with its mouth or opening, seeing that the watercourse is now worn down ten or twelve feet below the cave's bottom. Again, if we suppose it to have been excavated by the attrition of the waves of the sea during some remote period, when the waters of the ocean stood on a level with the cave, it must still have a very ancient origin, for the cave is situated upwards of thirty miles from the sea, and upwards of eight hundred feet above its present level. This locality must have been submerged during the glacial period, as we have evidence of by the deposits of boulder clay; and if the sea on receding should have remained on a level with the limestone for a great length of time, the result would have been the wearing down of the rock, or the hollowing out of crevices and caves in the exposed strata.

Fig. 2.—Transverse section of cave.

a Level of the Burn. *b* Level of cave (from *a* to *b* 10 feet). *c* Osseous remains in the cave, (from *b* to *c* 14 yards). *d* cave without remains, (from base of *d* to ground-line *f* 7 ft). *e* Limestone.

In a certain place of the cave-flooring, the workmen recently came upon a large sheet of stalagmite of varying thickness, but averaging about four inches. This calcareous incrustation has been formed by the ceaseless dropping of water holding lime in solution, from the roof of the cave. On removing this crust and a small portion of fine sand and silt, the workmen exhumed a human skull and a quantity of bones, some undoubtedly human, and others belonging to the lower animals. The human skull, according to its phrenological development, seems to indicate a low intellectual capacity, the forehead being low, and the circumference under the average standard. There is also a fragment of a skull which seems to have belonged to a tolerably large animal, as it measures three and a quarter inches from the medial line to the outside beside the ear, giving a breadth of six and a half inches for the whole skull; then if the integuments, hair, etc. be added, we should have a physiognomy little short of nine inches wide, and this creature may have been that of one of the principal tenants of the cave, and which probably devoured the others. Intermixed with the remains are very small pieces of bone, etc., partially cemented together by calcareous matter, and occurring in patches at different places; these have the appearance of coprolites. The bones are nearly all fragmentary, and much broken; the fractures being of an ancient date, thereby showing that the remains had been subject to violence and fracture *before* they were imbedded in their calcareous tomb.



[6 or 7 feet wide.]

Fig. 3.—Section of cave.

a Angular piece of Limestone, Sand, etc. Stalagmite. *c* Osseous remains, Sand, Silt, etc. *d* Stalagmite. *e* Open cave. *f* Limestone.

How long these remains have lain in the cave? by what means they have been carried and entombed there? whether the animal-remains belong to existing or to extinct species? and how the fractured bones are to be accounted for? are all very interesting palæontological problems.

The cave has in all probability been occasionally inhabited by wolves, foxes, etc., which would sally forth, seize their prey, and return to devour it, leaving the bones to be covered over by the stalagmite as we find them; the coprolites before mentioned seem to point to this conclusion. There seems to be not so much mystery about the animal bones being found there; but the case is quite different as regards the human. There is always something strange and startling in such occurrences, when human remains are found otherwise than reposing in the silent and hallowed precincts of a regular burying-place.

During the interment of these relics of some of the perhaps earliest members of our race, the rippling of running water on the cavern floor, the monotonous drippings from the roof, the growling perhaps of wolves, or the barking of foxes, and the bellowing of the wind through the gloomy chambers of the cavern, would form the only requiem.

It ought, in conclusion, to be observed, that the remains are deposited in a certain wing or chamber of the cave, about two feet above the floor where the water runs, so that they would lie dry, with the exception of the calcareous droppings from the roof, or in the case of the cavern water being swollen above the capacity of the lower channel to contain it.

Although a considerable portion of the cave has been destroyed by the quarrying operations, which are still going on, there remains yet a much larger extent undisturbed, so that more remains will most likely be discovered.

West Croft, Stanhope, by Darlington.
Dec. 17th, 1861.

[These bones, with specimens of the stalagmite, etc., have been transmitted to us and will receive careful study and consideration. We shall shortly give a concise and accurate account of them.—Ed. Geol., 22 Dec. 1861.]

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

Geological Society of London.—*December* 4.—Sir R. I. Murchison, V.P.G.S., in the chair. The following communication was read:—"On the Bracklesham Beds of the Isle of Wight Basin." By the Rev. O. Fisher, M.A., F.G.S. After noticing the researches of Prestwich and Dixon, the author proceeded to state that most of the "Bracklesham beds" are displayed at low water at Bracklesham Bay; but other and higher beds belonging to the same series are to be observed in the New Forest, at Stubbington, and in the Isle of Wight. By means of the fossils, for the most part, Mr. Fisher divides the series into four groups:—1. The uppermost abounds in *Gasteropoda*, and has several fossil-beds. One of these, in the eastern part of its range, is full of *Nummulina variolaria* (No. 16 of Mr. Prestwich's Section of Whitecliff Bay, Quart. Journ. Geol. Soc. vol. ii. pl. 9); the *N. variolaria* bed of Selsea and of Stubbington; and the Shepherd's Gutter bed at Bramshaw, New Forest. The beds above the last-named are—1st, a portion of No. 19 of the Whitecliff Bay section and the coral-bed of Stokes Bay and Hunting Bridge (New Forest); and 2nd, the shell-bed at Hunting Bridge, and pebble-bed, with shell-casts, at Highcliff. The lowest bed of this groupis the "Cypræa-bed" of Selsea, the "Cardita-bed" of Stubbington, and the Brook bed in the New Forest. 2. This group is more sandy than the last; it has two fossil-beds, one of which contains *Cerithium giganteum* (at Hillhead, Stubbington; and half a mile west of Thorney station, Bracklesham Bay). 3. This is a sandy group, and is remarkable for the profusion of *Nummulina lævigata* in its principal fossil-bearing beds. 4. This embraces the lowest fossiliferous sands of Bracklesham Bay. Its distinctive shells are *Cardita acuticosta* and *Cypræa tuberculosa*.

Some species of mollusks pass upwards from the Bracklesham into the Barton series; yet the Fauna of the Bracklesham beds has a sufficiently distinct facies; and the following species range through this series, and are confined to it—*Cardita planicosta*, *Sanguinolaria Hollowaysii*, *Solen obliquus*, *Cytherea suberycinoides*, *Voluta Cithara*, and *Turritella sulcifera*. *Pecten corneus* is also characteristic, but is met with higher up.

The Bracklesham beds seen at Whitecliff Bay were first treated of, and Mr. Prestwich's section referred to in detail. No. 6 (a pebble-bed) of this published section is regarded by Mr. Fisher as the base of the Bracklesham series; the upper limit being somewhere in No. 19. Descriptions followed of the beds seen at Bracklesham Bay; the eastern side of Selsea; at the Mixen Rocks; at well-sinkings near Bury Cross; at Stubbington (including the Cerithium-bed at Hillhead, discovered by the author in 1856); Netley, Bramshaw, Brook, and Hunting Bridge (where H. Keeping has lately found a fossil-bed high in the series), in the New Forest. Indications of the western range of the marine shells of "Bracklesham" age were quoted as occurring at Lychett, near Poole, and as very rare (one *Ostrea*) near Corfe.

Bracklesham beds, containing marine forms, seen at Alum Bay, Isle of Wight, and at Highcliff, near Christchurch, were then described in full. The Bracklesham series is regarded by Mr. Fisher as commencing in both these sections a few feet beneath a dark-green clay (part of No. 29 of Mr. Prestwich's section of Alum Bay) containing a peculiar variety of *Nummulina planulata* and many shells of the Barton Fauna.

Remarks were also made on the estuarine condition of the lower Bracklesham beds in their western area; on the probable sources of their materials; on the successive deepenings of the old sea-bottom, and the formation of the pebble-beds; and lastly, on the fitness of the Bracklesham and Barton series as a field for research in the history of molluscan species.

The paper was illustrated by a series of specimens from the author's collection.

Specimens of gold in quartz-veins, of gold-dust, and of gold-ingots, from Nova Scotia, sent by Mr. Secretary Howe, were exhibited by Professor Tennant, F.G.S.

CORRESPONDENCE.

Northampton Sands.

Dear Sir,—The November number of your valuable journal contains a paper by Mr. J. H. Macalister, on "The Fossils of North Bucks and the adjacent Counties," in which, I believe, reference is made to myself in the following passage, page 481:—"The identity of the Northampton Sands (formerly classed with the lias) with the Stonefield Slate of Oxfordshire and Gloucestershire, and constituting the lower zone of the Great Oolite;" and in a note it is added, "so classed by Dr. Wright, being separated by him from the inferior oolite, which they formerly were supposed to represent."

To this statement I have simply to say, that Mr. Macalister is altogether incorrect, as I have nowhere classed the Northampton Sands with the lias, nor made any reference to them. If that gentleman will refer to my memoir on "The Palæontological and Stratigraphical Relation of the so-called Sands of the Inferior Oolite" (Quart. Journal of the Geol. Soc. vol. xii. p. 292), for 1856, he will find a full statement of the case, as regards the counties of Gloucester, Somerset, and Dorset, but no reference whatever to Northampton; and in the preface to my 'Monograph on the Oolitic Echinodermata,' p. ix., he will find it stated that "in every

SECTION OF THE CHALK CLIFFS UNDER DOVER CASTLE, KENT.

S. J. Mackie, F.G.S., del.

instance, *with the exception of the Northamptonshire beds*, which have been carefully noted by my friend, the Rev. A. N. Griesbach, I have visited the localities given in this work," but in no part of that monograph has my friend referred the Northampton Sands to the lias. Mr. Macalister has been therefore altogether misinformed on this subject. I submit that it ought to be a rule with gentlemen furnishing papers to the valuable pages of the 'Geologist,' in *every case* to refer to the original articles from which they quote. Yours most truly,

THOMAS WRIGHT.

Cheltenham, November, 1861.

NOTES AND QUERIES.

SUBDIVISIONS OF THE CHALK FORMATION.—The generally accepted subdivisions of the chalk are,—1, Upper White Chalk with bands of Flint nodules; 2, Middle or Lower White Chalk; 3, Grey Chalk or Chalk Marl.

These have been in undisputed use for very many years, not because they do not require any modification to render the accordance more definite and more rigidly corresponding to the accumulation of information which has been going on since their introduction, but chiefly because chalk,—at least English chalk,—is white or of a pale grey, which when the beds are in a dry state is so nearly white, that ordinary eyes do not see the difference, and ordinary collectors do not care about it so long as they can get hold of a fine fossil.

Still, however, it is very necessary, and high time that some one should take in hand to define accurately the lines of division, especially that between the upper and lower white chalks.

I doubt very much that the cessation of the bands of flints denotes the demarcation between the upper and lower white chalk (middle chalk of some authors): they should be properly, and must be ultimately, separated by a characteristic difference in the distinguishing organic remains.

With the lowermost bands of flints (Plate II. *a*) very numerous beds of ventriculites and sponges set in, and are continued far below the termination of the layers of flints, down to a very thick bed of pure white chalk (*b*), that rests upon a very marked and peculiar stratum about two feet thick (*c*), which, from the weathering out of its upper and under surfaces, forms a marked line as far as the eye can see the distinctions of bedding all along the coast.

This bed, in my own note-books and in conversation, I have familiarly termed the "two-foot stratum."

Below this we have again a thick bed of white chalk, free from flints. At least, such is the order in the section to which these remarks more particularly refer, namely, that presented by the East or Castle Cliff at Dover, of which we give a view in Plate II.

This "two-foot stratum" is persistent throughout Kent, and I have met with it both in Surrey and Sussex, and it will therefore probably form one of the best and most unmistakable guides in inland quarries to those particular beds of white chalk to which we wish to draw attention, for the purpose of getting all the information we can as to their geographical area, order of succession, and organic contents in other chalk districts, so that the true horizon of division, as formed by distinctiveness of organic remains, may be properly made out.

We shall be obliged by communications, and stratigraphical lists of fossils from our readers and correspondents, to assist us in our labours in determining this interesting point of Whether the ordinary division into "white chalk with flints," and "white chalk without flints," is not merely a mineralogical division, and not a proper geological subdivision characterized by distinctive organic remains, and marking out a positive zone in the succession of geological events and of life-forms; or Whether a distinguishing alteration in the organic remains of the white chalk does not happen so near the horizon of cessation of flint layers, that by including or excluding some few beds of chalk, those valuable and characteristic petrological features (of chalk with, or without flints) may not be made more precisely valuable and definite than at present. S. J. Mackie.

Lower Silurian Fossils at Builth.—The neighbourhood of Builth affords excellent specimens of many of the Lower Silurian fossils, especially trilobites. It may be useful to inform amateur and professed geologists that the little town of Builth contains a good practical geologist in the person of Mr. John Jones, gardener at Pencarrig House, who, though in humble circumstances, possesses a capital knowledge of the fossils of the district, and the localities where they may at once be found. He is willing at all times, so far as his duties permit, to become the pioneer of geological visitors at Builth, and will, for a suitable consideration, forward specimens to correspondents. Several amateurs of high standing, as well as professors, have availed themselves of his knowledge to the enriching of their collections. Within the last twelve months I have received from him some excellent specimens of Trilobites (*Ogygia Buchii, Ampyx nudus, Trinucleus concentricus*, etc.), also specimens of *Didymograpsus, Graptolithus, Rastrites*, etc. I make this statement that others wishing to have their collections of Lower Silurian remains added to, may know whither to look for aid.—A Leominster Subscriber.

Mammalian Remains.—In the 'Philosophical Transactions' for 1715, vol. xxix., two teeth of Elephas, probably *E. antiquus*, are recorded to have been found in the north of Ireland, at Maghery, eight miles from Bulturbet, in digging the foundation of a mill near the side of a small brook that parts the counties of Cavan and Monaghan. They were about 4 feet underground, and about 30 yards from the brook. The bed on which they lay had been laid with ferns, and with that sort of rushes here called "sprits," with which brushes and nut-shells were intermixed. Under this was a stiff blue clay, on which teeth and bones were found. Above this was, first, a mixture of yellow clay; under that a fine white sandy clay, which was next to the bed. The bed was, for the most part, a foot thick, cutting like turf; and in every layer the seed of the rush was as fresh as if new pulled.

In the 'Philosophical Transactions' for 1754, vol. xlviii., there is a record of several bones of an elephant found at Leysdown, in the island of Sheppey, by Mr. Jacob, surgeon, of Faversham. Three or four years before, Mr. Jacob had sent the acetabulum of an elephant, which was discovered sticking in the clay which was partly washed away from the cliff, about a mile eastward of the cliffs of Minster. This, with other parts—vertebræ, a thigh-bone 4 feet long, too rotten to be taken up entire—all lay below high-water mark; and as the place soon after became his property by purchase, he then went, attended by some workmen, in search of more relics, and found a tusk 8 feet long and 12 inches in circumference in the middle, besides other bones within 20 feet of those first recorded.

Fig. 1.

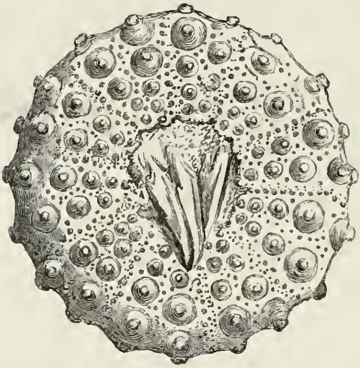
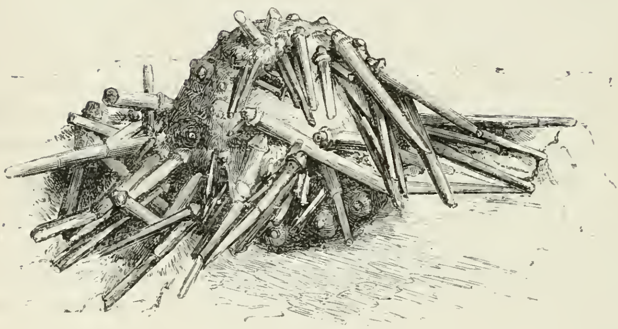


Fig. 2.



CYPHOSOMA KŒNIGI.

[From the Upper Chalk of Gravesend, Kent.]

In the National Collection, British Museum.

S. J. Mackie del.

THE GEOLOGIST.

FEBRUARY 1862.

NOTE ON KÖNIG'S SEA-URCHIN. (*Cyphosoma Kœnigi*, Mantell.)

By S. P. Woodward, F.G.S.

One of the commonest fossils of the chalk in the London district is the beautiful Sea-Urchin, of which we here give two figures, from examples in the national collection. It was named by Dr. Mantell, in honour of Mr. Charles König, the distinguished German *savant*, who in his youth was Librarian to Sir Joseph Banks, and became afterwards the Keeper of the Natural History Collections in the British Museum. By the country people in Wiltshire it is called the "Shepherd's Crown."

The König's Sea-Urchin belongs to a subdivision of the old Linnean genus *Cidaris*, to which the name of *Cyphosoma* was given by Agassiz (from κυφὸς, *curvus; σῶμα, corpus*). The five ambulacral bands are nearly as broad as the inter-ambulacral, and are ornamented with a double series of tubercles equal in size to the rest. These tubercles are placed on crenulated bosses, but are not perforated as in most of the *Cidaridæ*.

The upper and under sides of this fossil Urchin are so different that drawings of them might be taken to represent two distinct species. The under side exhibits ten pairs of rows of tubercles, largest at the margin, and diminishing gradually to the central orifice. On the upper surface the tubercles are much smaller, and there are two additional rows on the inter-ambulacral bands, external to those which are continued downwards over the base. This character was pointed out by Dr. Mantell in his original description of the species, and serves to distinguish it from another form, nearly equally common in the chalk, which is figured and described by Goldfuss as *C. granulosus*, but is generally regarded as a (perhaps sexual ?) variety, having a more tumid shell, and with the additional rows of tubercles on the upper surface rudimentary or obsolete.

The pairs of ambulacral pores in *Cyphosoma Kœnigi*, form ten winding lines from the mouth-opening (*peristome*) to the apical orifice (*periproct*). They are somewhat crowded at the mouth, but extend in single file to a little above the circumference, and then fall into double series on the upper part of the shell. The specimen represented by fig. 1 exhibits a portion of the dental apparatus, lying in the peristome, and consisting of one of the five pairs of jaws which are similar in all the *Echinidæ*, and form the 'lantern' of Aristotle.

Young and half-grown specimens of *Cyphosoma Kœnigi* are comparatively rare. They may be recognized by the flatness of the under surface, which distinguishes them at all ages, while in the little *C. corollare* (Parkinson) the base is rendered concave by the curling inwards of the margin of the peristome. In the other common little species, *C. spatuliferum* (Forbes), the ambulacral pores are ranged in single file throughout their course.

The spines of *Cyphosoma Kœnigi* are awl-shaped and rather short and stout, with spatulate ends. In the second example figured, a multitude of spines of all sizes were preserved in connexion with the shell, and have been cleared from the matrix with great skill and ingenuity by Mrs. W. H. Allen.

There is another specimen in the British Museum with the spines remaining *in situ*, which was obtained more than a century ago, and formed one of the ornaments of Sir Hans Sloane's collection.

Although common in the chalk-pits of the Thames Valley, and in those near Brighton and Lewes, the *Cyphosoma Kœnigi* appears to be unknown to the collectors of fossils from the uppermost division of the chalk at Norwich, or in the corresponding bed at Ciply in Belgium, and Meudon near Paris. It is said to be found at Montolieu, in the department of Drome, at Dusseldorf, and in the island of Rugen in the Baltic.

SKETCH OF THE GEOLOGY OF THE TORBANE MINERAL FIELD.

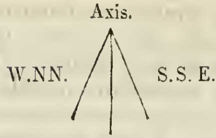
By Andrew Taylor, F.R.P.S., F.B.S.E.

The various corps of an army drawn up in line of battle are distinguished not only by their various uniforms, but also by the distinct position assigned them in the field. This greatly helps the general to the immediate disposition of sharpshooters, infantry, or artillery, as the fate of battle may require. Most of the minerals which are the basis of our commercial and mining greatness are obtained from the Carboniferous system. The industrialist obtains them from various parts of this formation. When a new substance has presented itself, having characters very different from the ordinary rank and file of coals, clay-bands, or fire-clays, its stratigraphical position will help us to determine if it is entitled to a distinct character. If its place be distinct from those of the ordinary coals, if likewise there are indications of a different physical mode of formation, then its claim to be a new mineral will be greatly strengthened.

The lower carboniferous rocks of Scotland consist of shales and sandstones more than a thousand feet thick, termed by Mr. Maclaren the calciferous sandstone series. A freshwater limestone, equivalent to that worked at Burdie House, near Edinburgh, is the predominant member of this group. This limestone runs in an elliptical area round that city for nearly twenty-four miles, extending through Fife, Midlothian, and Linlithgowshires. Part of this series extends to the south-east of the town of Bathgate, round which is the Torbane Hill mineral basin. A geological section in the Bathgate Hills, taken from Dechmont-law to Balbardie House, exhibits a limestone containing freshwater fossils, and equivalent to the one worked at Burdie House, gradually merged into another limestone containing marine fossils, which is usually recognized as the lowest bed of the carboniferous series.

The axis of the hills occurs in a wooded prominence overlooking the Caputhall Bogs, and near the "Clinking Stane." At this point the limestones may be traced within a few hundred yards of each other, dipping north-north-west and south-south-east. The Kirkton limestone, a peculiar bed, described by Dr. Hibbert, containing both marine and fluviatile remains, intervenes. Eastward from the prominence just indicated, both the axis of the hills, and the connexion of the limestones, may be traced in the burn running through Bangour Farm, at Binny, and thence at various points to the shore of the Forth at Hopetoun.

From the section described, the succession of the strata on either side of the axis, comprising the country eastward to Edinburgh on the one hand, and westward to Shotts on the other, is as follows:—



3. Upper Lanarkshire coal measures:—Wholly fluviatile organic characters.	3. Sandstones, shale, and a bed of coal.
2. Beds of marine and fluvio-marine limestone intercalated with shale, coal, ironstone, and stratified trap.	2. Freshwater limestone.
1. Shales, sandstones.	1. Shale, sandstone, tufa.

On the Bathgate Hills the marine limestone is sixty feet thick, and the fluviatile limestone about twenty feet thick. But towards the south-west, on the borders of Edinburgh and Lanarkshires, the marine limestone thins into beds of from three to six feet thick, whilst the freshwater bed is above fifty feet thick.

The Torbane Hill bed lies in number two of the left-hand series of strata. Along with two or three local coal-seams, it occupies a small mineral basin some two or three miles in area, lying immediately above the mountain-limestone, but stratigraphically distinct from the upper Lanarkshire coal-measures. The petrological structure of the surrounding strata is very unique; let us try to evolve their history.

The physical changes closing the life-era of the Scottish old red sandstone system are difficult to determine. From various geological reasons, the chief of which are the wave-ripples on the sandstones, and the physical structure of the surrounding mountain-chains, it has been deduced that central Scotland was a strait or frith bounded as now by the prominent peaks of the northern and southern Highlands. Islets, covered by a strange vegetation, dotted this watery expanse; from the eastward strong currents brought down the spoils of a now lost land, depositing the shales and sandstones so predominant round the Scottish metropolis. In this quarter, too, an intense volcanic activity prevailed.

The trappean bosses, which form so prominent a feature in the landscape round Edinburgh, were mostly erupted at this time. So, at least, the labours of Mr. Geikie and others go to prove.

From St. Abb's Head to Bathgate a chain of volcanos sent up their lurid contents into the Carboniferous sky. Nowhere was this activity more intense than on the Bathgate hills. The freshwater series to the eastwards of our section are everywhere intercalated with trap; some of it developed as aerial ash-beds, the rest as submarine greenstones. The prominences round Winchburgh, Binny, and Linlithgow, which the railway-traveller may remember so boldly characterize the scenery, are the memorials of these eruptions. The spot pointed out as the axis of the hills was undoubtedly the vent of a very active volcano. Immediately above Bathgate four or five great beds of basaltic greenstone and ash lie so intercalated with the aqueous strata as to be only explicable on the hypothesis that they were emptied at the same time that the other strata were deposited.

The chemical changes effected by these igneous strata on the surrounding rocks are likewise very curious. In many places the limestone is changed into a crystalline marble. One bed at Kirkton affords undoubted evidence that it was deposited by a thermal spring. The great thickness the main bed of limestone in the hills attains, may be accounted for as much from its being a chemical deposit, as one of animal origin. The sandstones and shales, too, are often curiously baked, showing the violence of the igneous agencies. But we call special attention to the prevalence of bitumen in the district, sometimes appearing solid in the crevices of the sandstones, as at Binny; sometimes in round circular nodules in the trap or limestones; and sometimes oozing out liquid from trappean reservoirs.

The circular type of structure is very prevalent in the aqueous rocks of the district, as in the sandstone at King's Cavel, and amongst the ironstones. It extends throughout the rock systems. It is most manifest in the oolite or roe-stone of another formation. However we may explain it, it is clearly the result of agencies at work when the sandstones and shales were depositing, and not a subsequent chemical change. This admitted, it follows that most of the bitumen of the district is contemporaneous with the igneous rocks, and that the highly bituminous sandstones and shales were saturated at the period of their deposition. The clearest proof of this is the structure of the celebrated Binny sandstone. How else can we explain the black bituminous patches appearing on its surface? The physical agency at work may have been the conjunction of two rapid currents. But it is much easier to suppose the bitumen ejected from some neighbouring volcano floated in the waters of the lagoon or river in which the sandstone was forming, and then mechanically mingled with it; than that the sandstone was subsequently saturated from beneath.

Facts connected with the occurrence and formation of bitumen at the present day bear out this hypothesis. Its connection with volcanic agency is well known. The celebrated pitch-lake of Trinidad stands in close proximity to a volcano, as also do some of the bituminous localities in Asia Minor. All the three varieties of this substance float on water. Maltha, or mineral pitch, floats on the surface of the Dead Sea. Petroleum floats on the Tigris and Euphrates, so much so, that the surface of the river is often set on fire. The boatmen on the Tigris and Euphrates are paid in this substance. Doubtless at the bottom of these rivers there are many nascent beds of richly bituminous shales.

Given then a series of submarine volcanos ejecting out sheets of liquid bitumen, and at the same time sand and mud rapidly deposited; let these commingle, and we have the rationale of the formation of the Binny sandstone, and the bituminous shales of Queensferry and Broxburn. These forces ceased after a time. A morass was slowly formed which now constitutes the Houston coal-bed. This indicates another condition under which bitumen was eliminated. In this case it is the result not of mechanical deposition, but of subsequent chemical action from decaying organic substances. Again, the action of the currents was resumed, and fresh bituminous shales were formed.

When the contemporaneous traps on the north-west side of our section were ejected, the same succession of physical changes continued. Bitumen occurs in globules both in the contemporaneous traps and in the limestones. The limestones indicate three marked alterations in the level of the land. First, the Kirkton limestone, with its leafy laminæ, and curiously baked beds of cherty porcelain, its interstratified ash, and over-capping basalt indicate proximate volcanic activity when forming. Fluvio-marine fossils are found in it. The land then sank so far as to allow the building corals to commence their labours; a reef was now formed which was added to by shells dashed in by the surf from the neighbouring sea, and the precipitation of carbonate of lime from a sea surcharged from its proximity to a volcanic cone; thus the great belt of the limestone of the hills was formed. But immediately after the land was subject to as rapid an elevation; as is manifest from the Stigmarias found in the upper bed of the limestone,—the lower beds abounding in deep-sea shells. Ash-beds also cover it. The hills now seem gradually to have risen above the waves, and a prevalence of freshwater strata filled the small Torbane Hill basin. But all this time the volcano did not stop its activity, as is evidenced by the thick ridges of interbedded basalt which may be traced terracing the country upwards from Bathgate. It is easy to suppose that sheets of bitumen, as at the prior period of the Binny sandstone, floated on the waters of this lagoon; that in one time in particular, a very large quantity was given out, and thus, aided mayhap by ejections from beneath, the Torbane Hill bed was formed. May not the round circular masses in the Torbane Hill mineral, which so puzzle microscopists, be the result of the action of currents,—only, however, on a smaller scale than those visible to the naked eye in the other rocks of the district? In suggesting this hypothesis we make allowance for the fact that at other times the basin was elevated so that morasses could accumulate, and thus the beds of coal be formed. The district thus exhibits evidence of both modes of the elimination of bitumen.

In the upland country west of the Torbane Hill basin there is a singular absence of trappean ridges. The district rises into a series of undulating hills formed solely of the upper members of the carboniferous system of Lanarkshire. The lower carboniferous volcano had ceased previous to their deposition; and the Bathgate hills probably formed elevated land at the base of the great strait in which these strata were depositing. Slowly the land rose and fell, morass after morass accumulated to be compressed into future coal-beds after being covered over by sand and mud. Bitumen was thus formed through chemical agencies. Its source is manifest from the microscopic structure of the coal, which is entirely of woody origin, not exhibiting traces of clay or sand from drift. The beds of this upper formation were deposited over a wide area, and, unlike the Torbane Hill basin, with the greatest uniformity. This upper coal-basin then strikingly contrasts with the unique character of the Torbane Hill basin; and greatly aids our argument that the mineral was formed under different physical conditions from those of the true coal-beds.

NOTES ON THE METAMORPHOSIS OF ROCKS IN SOUTH AFRICA.

By Dr. R. N. Rubidge, of Port Elizabeth.

It is near eleven years since that in travelling through Howison's Poort,* one of the most picturesque of the many fine mountain passes through the quartzite ranges of the eastern province of the Cape Colony, my attention was drawn to a geological fact to which observation in other parts of the Colony has since led me to attach no little importance. In the construction of the main road from Port Elizabeth to Graham's Town, many deep cuttings have been made in the solid quartzite rock. In many instances the rock seen in these works lost its crystalline character gradually, and assumed that of a hard blue sandstone, and at length nearly resembled the blue fossiliferous shales and sandstones of the Ecca.

These quartzite rocks have been referred to the age of the Carboniferous formation of Europe by Mr. Bain (Geol. Trans. vol. vii. 2nd series, pp. 54 and 183), and both he and Dr. Atherstone ('Eastern Province Magazine,' vol. i. p. 588) describe them as conformable with the slaty rocks of the district. I have no doubt whatever that they generally are so. They pass gradually into each other, and, as I have described, the quartzite traced downward loses much of its siliceous character, and gradually assumes that of the slate and of the Ecca rock. This last is by Mr. Bain dissociated from the Carboniferous formation, and made the lowermost of the Lacustrine or Karoo series, but I have the following reasons for differing with him:—

1. At the western entrance of Howison's Poort are some beds of rock, intermediate in lithological character between the quartzite and the Ecca beds. These contain vegetable stems which have been recognized by many as identical with those of the Ecca. At Forester's Farm, east of Graham's Town, is a blue rock, just like that of the Ecca, containing the same fossils, which passes gradually into the gneiss. The sandstone on the one side is in relation on the other with the claystone-porphyry of Bain, as is the rock at the Ecca. Near Salem, in the heart of the Carboniferous system of Bain, are similar rocks with like fossils, conformable with the quartzite.

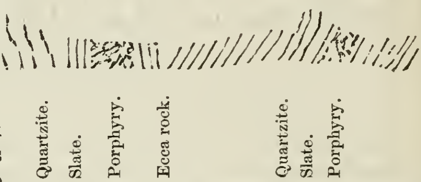
2. The strike of the inclined rocks, quartzites, slates, and Ecca rocks is throughout the province north 60° west nearly. If we draw

* Poort, a natural pass through a mountain range.

a line of eight miles through Graham's Town and near Salem, at right-angles to this direction, it will pass through little but quartzite. If we draw a line of the same length through the Commadagga beyond the Zeurberg, it will pass through nothing but slates, Ecca rock, and claystone porphyry.

3. On the road to Graaff Reinet is a place called Wolve Krool. It is a plain, bounded by quartzite hills. Its section is this:—

Fig. 1.



Here the Ecca rock contains its characteristic fossils, is conformable with the quartzite, and is separated from the Dicynodon rocks by a highish mountain of quartzite and many miles of slate, porphyry, etc. I could add many other reasons for this belief, but I think these will be sufficient. What is then the true relation of the quartzite to the Ecca rock and the slates? and how is it that at one part of a line of strike the rock will be all of a blue slaty fossiliferous character, and at another all crystalline quartzite, destitute, or nearly so, of fossils? How is it that in deep sections, natural as well as artificial, such as are made by cutting roads or by deep gullies, the slaty rocks are found below gradually passing upwards into quartzite? Of this I could give scores of instances, but I will select only one natural one. The range of quartzite on the left-hand of the section is crossed by a bye-road. This road passes for a mile or more over well-marked Ecca rock, with the high quartzite hills on either hand. The quartzite on the right-hand dies out, and the road to Graaff Reinet passes over Ecca rock in the corresponding part of the section.

I found what I believe to be the key to the explanation of these facts in Namaqualand. In passing through Ezel's Poort, between Springbok Vontein and Spectakel, I was shown a section which had been noted by Dr. Atherstone as remarkable. The gneiss hills were covered by horizontal layers of quartzose sandstone, and these were continuous on the western side of the hill with like quartzose sandstone dipping at a high angle westward, conformably with the gneiss. It was clear that this change of dip was not due to any upheaval, for the horizontal sandstones were found undisturbed a few yards distant. I soon learnt to regard this juxtaposition of horizontal and inclined beds, this continuity of quartzite conformable and unconformable with its subjacent rock, as a normal state of things in Namaqualand. When I saw high mountains with like structure, I was at first a little staggered, but soon felt convinced that even on this scale the phenomenon was due to the assimilation to each other by a process, common to both, of rocks of widely different ages.

In the Western Province I made, in a rapid journey from Cape Town to Ceres, a selection from the clay-slate to the Upper Silurian of Bain. I had reason, as far as I was able, to confirm the truth of Mr. Bain's section, while differing from him in the inference I drew from it. I believe his wide dislocation of the Ceres beds from the clay-slate to be an error into which he has been led by a state of things like that of Ezel's Poort. I have never been able to get direct proof that this is the case here, although I have elsewhere, as shall presently appear.

On my return to the Eastern Province, I thought I saw evidence of the siliceous change of rocks on a much greater scale than I had observed them in Namaqualand. I wrote a Paper on the subject, and published it in the local magazine I have quoted above ('Eastern Province Magazine,' vol. ii. p. 187). I hoped it would have led my friends here, from whose sections mine differed considerably, to re-examine their data. A little after, I sent home a Paper which was read at the Geological Society of London (see an abstract of it in the 'Geological Society's Journal,' vol. xv. p. 195), in which I explained these views, and predicted that the clay-slate of the west would hereafter be found identical with the Upper Silurian of Bain, and the Carboniferous rocks of the east identical with both, the quartzite being changed rock, sometimes slate itself, sometimes a newer unconformable rock. Of this identity I was enabled to send home strong presumptive proof in the shape of fossils identical with the Upper Silurian of Bain, from the clay-slate on the western shores of Francis Bay. More recently I have obtained the same fossils (pronounced Devonian at home) from various points between the Kromme and Kabeljouw rivers, St. Francis Bay, in the clay-slate, and from Chatty, near Port Elizabeth; from Naroo, near Uitenhage; from Blauw Krants, on the Bezuidenhouts river, on the road to Graaff Reinet; and from the northern base of the Coxcomb in the Winterhoek range in the Carboniferous. Still, it might be objected that there may really be a difference between the clay-slate and the Devonian, though Mr. Bain may have mistaken the line of division. If reference be made to the Admiralty chart of St. Francis Bay, it will be seen that the low shores of the bay are crossed by a range of mountains of considerable elevation. These mountains, which are quartzite, cross the strike at a considerable angle, nearly, in fact, for some distance at a right angle; so that on the beach and the low hills you may cross near ten miles of slate, perhaps five miles of strike, while six or eight miles inland, on the heights, the corresponding part of the section is all quartzite. The quartzite must, consequently, cross unconformably the slates, and therefore be newer than they. The reasons why they cannot be older, I need not give here, as I have given many of them above. These same quartzite hills are continuous with others of the same lithological character, which are decidedly conformable with the Devonian rocks, though they too cross the strike at an angle of 30°. I have not had opportunities for such an examination of the country between this and Cape Town, as to enable me to say positively that there are no beds older than the Devonian; but I think I have shown satisfactorily that the evidence on which the clay-slate is referred to a much higher antiquity is fallacious. I can safely assert that the Devonian beds of this country are crossed by lofty ranges of quartzite, often unconformable with them, which quartzite is continuous with like quartzite conformable with the Devonian beds. Whence I infer *that the rocks of a tract of country may be so altered by molecular changes common to all (probably in the instance of our rocks the infiltration of silica), that beds of widely different ages may present the same lithological character*, and that when horizontal quartzose (or calcareous* or felspathic ?) rocks are continuous with inclined rocks of the same kind *it is not always safe to infer that beds resting conformably on the latter are much newer formation than those on which the sandstones rest unconformably*, that the beds *a*, *b*, are very far older than *c*, *d*, for instance.

Fig. 2.

It is my conviction then (though I admit that my evidence is not quite conclusive) that the inclined slaty rocks of this Colony, west as well as east, all belong one formation, which geologists at home have, on the evidence of fossils, pronounced to be Devonian; and that the quartzite is a rock which has undergone a superficial change, and may therefore be called metamorphic. This siliceous metamorphosis is associated with other changes. The clay-slaty beds are often converted into ochry, micaceous, and chloritic schists.

There is not in the Eastern Province much evidence of ordinary metamorphic action, except in the claystone-porphyry of Bain, which I regard as a product of metamorphic action, as I shall more fully explain hereafter. At the Matland mines, about twenty miles west of Port Elizabeth, are slates like those which at Chatty contain Devonian fossils. Some of these have been converted into chloritic, hornblendic, and micaceous schists, without any evidence of the proximity of eruptive rocks. In the planes of bedding of these schists are veins of quartz, and occasionally carbonate of lime, not very rich in copper-pyrites. I regard the hard blue crystalline limestone of the same locality, in which lead and zinc ore occurs, as partially, at least, metamorphic. At George and other places intermediate between Cape Town and here, granite occurs, but as I have had no opportunity of examining it, I shall trace the evidences of metamorphic action from Cape Town northward.

At Cape Town I found granite-veins varying from one to three feet to as many lines diameter running parallel with the strike of the clay-slate rocks without displacing them, showing, I think, that they had been changed *in situ*. Other veins crossed the strike. Again,

* I think I saw calcareous beds of which all I have asserted of the quartzite might be predicated.

isolated masses of slate preserved their dip unaltered in the midst of granite which appeared to have a dip in the same direction. Passing north-westward towards Namaqualand, I saw the slate near Heerlozement so little altered and so like some of the fossiliferous rocks of the Eastern Province that I much regretted that my engagements did not permit of a closer examination of it. At Olifant's river the rocks, still with the same strike as in Cape Town, viz. nearly magnetic north (north 30° west), had assumed a micaceous and talcose character, and on the northern bank of the river were much impregnated with iron. Four or five miles beyond Kokonap I saw the slate for the last time till I met it at the Orange river, and here it abounded in a peculiar form of cyanite which I afterwards found in great abundance in the gneiss and mica-schist of De Kiet, near Hondeklip Bay. Some grassy country intervened between this spot and the next where rocks were visible. These were felspathic in great variety. I could not get a satisfactory observation of their dip for some days' journey, perhaps owing to the little experience I had then of rocks of this class. There are few things I have more to regret in the way of lost opportunities than the want of a careful examination in detail of the country within ten miles' radius of the lowermost ford of the Olifant's river. It would include a section from the clay-slate to the Upper Silurian of Bain which are found in the Cederberg as well as the passage of the former into the felspathic rocks of Namaqualand. Bain has no hesitation in affirming this change, and I have every reason to think that he is correct; but believing as I do in the identity of his clay-slate and the Upper Silurian, I cannot but regret that I was unable to make a thorough examination of the country. I believe Bain's separation of the clay-slate from the Upper Silurian (Devonian) are drawn here as elsewhere from the position of the quartzite crossing the slate and underlying the Devonian. Is not this evidence identical with that on which metamorphic formations are assigned to widely distant epochs in Europe?

In addition to the want of time and of experience referred to, I have to regret the loss of a note-book in which my observations on the rocks in the earlier as well as later part of my journey in Namaqualand were inserted. I cannot therefore tell from my own observations how the strike of the rocks which was north 30° west at Olifant's river, assumes a nearly east and west strike at Springbok Vontein. As we pass northwards it takes a more northerly direction, and at Oograbis it is north 60° west, and at Annies, on the Orange river, it resumes its north 30° west strike with its slaty character. I have no hesitation in affirming the passage of the slate into felspathic rock here.

Assuming, then, the metamorphosis of palæozoic rocks into gneiss, mica-schist, etc., I will merely reiterate my firm belief that those of Namaqualand are the changed condition of the great mass of slaty beds which extend from the mouth of the Fish river in the east to Cape Town, and thence to Olifant's river, and at various points contain fossils which have been referred to the Devonian epoch by geologists of Europe. I again admit that the evidence by which I have attempted to establish this is somewhat defective, but I have shown clearly that that on which it is denied is valueless.

I have already described the interpolation of masses of granite among the slate of Cape Town without displacement: this phenomenon obtains to a much greater extent in Namaqualand; great masses of granite, with little if any evidence of stratification, pass gradually into gneiss on either side, and, in fact, all round, without change of dip. These are called locally "bosses," and their scaling off is remarkable, giving them the rounded outline, whence their name. The same thing is seen in the change of hornblende-schist into greenstone or syenite, with large crystals of hornblende. Numerous instances of this occur; one of the most striking is between Klein Pella and Oomsdrift.*

I have mentioned in a former Paper that the twists of the strata in which the copper-ore is deposited occur in gneiss, and when a section is seen on a hill-side no granite is visible, but when worked to any considerable depth, the rock loses its laminated character and becomes a felspathic granite or greenstone. A remarkable section was observed near Pella: a stream had worked a deep channel in the rocks; the edges of the ravine so formed were of well-marked gneiss, while the water ran over a bed of granite without trace of lamination, the gneiss preserving the same dip on either side of the ravine. Indeed, it appeared to me as if metamorphosis of the rock into felspathic granite was the normal state below, while the gneissic lamination was a superficial indication of the old stratification-planes. While on this subject I will mention what appears to me to be a singular character of our palæozoic rocks here. The specimens I have sent home will show that all the Devonian fossils here lose every trace of their carbonate of lime. They are preserved, often very perfectly, in oxide of iron, but in my experience they are seen only on the exposed edges of the rocks, be these greatly inclined, as at Chatty and Hermansdorp, or only slightly so, as at Coxcomb and Jeffrey's bay. At Chatty I have seen a mass hollowed out in all directions by the decay of the encrinites on the edges, while tracing the same layer deeper in, it lost all trace of fossils. Frequent repetitions of this seemed to me to establish it as a rule that the fossils in the rock were only exposed by decomposition. Still it may be merely accidental. I should be glad to learn whether it is so or not.

I have stated that in the metallic twists, or saddles, I never saw granite in what I could consider the position of an intrusive rock. In one of the accessory twists which meet the metallic saddles at various angles, and which in section on a flat surface have the appearance of a feather, the shaft (*a b*) of the feather was composed of micaceous schist, with a few rather large crystals of felspar. I have frequently seen irregular-shaped patches of mica-schist following neither strike, nor any law that I could perceive, among the gneiss. Granite occurred in the same way in other spots.

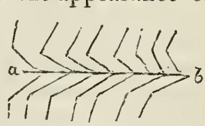


Fig. 3.

* Drift-ford (of the Orange river).

It is well known that prehnite is a common mineral in some parts of this colony. It occurs in the dioritic or syenitic dykes of the Dicynodon strata, and is evidently a product of the re-arrangement of the minerals of these dykes during their decomposition. The prehnite is found in laminæ between the decomposing masses of the dykes and on their faces as digitate concretions. Unlike M. Daubrée's zeolites it has not required heat for its formation, but, like them, it is forming at this hour by aqueous action. I have almost as little doubt that dykes and other masses of granite are forming in the same way from the re-arrangements of the constituent minerals of the gneiss. I find it easier to feel the truth of this on the spot than to convey it to others; still I will endeavour to give some reason for my faith. One mass of gneiss, near Henkrees, in which a vein of granite, terminated by an expansion about a foot square, proceeded along the gneiss. It was quite evident that there was no intrusion, no connection with any mass below. Spindle-shaped masses of granite placed between beds of felspathic, micaceous, and other rocks, were numerous and could often be entirely removed by a hammer, showing they had no connexion with any subterranean mass. Spherical lumps of granite or syenite were frequently quite isolated in the schists of the mines. I have stated before that beds of quartzite appeared to be intercalated by a filtration from above; some of these could be traced down till they became mixed with mica and then with felspar, and not very much deeper assumed the character of the gneiss of the country. Other masses, which seemed to be intermediate between these, toward the spindle-shaped granite lumps above, were composed principally of quartz, with a few grains of mica and felspar, and occasionally garnets: these were surrounded by mica-schist *in bent-up strata;* yet the whole mass, perhaps twenty pounds or less in weight, could be removed. These circumstances seemed to me to prove clearly that if felspathic rocks of any kind are the products of metamorphic action, then are granite, syenite, etc., traceable to a like origin; that if, as I think, I have clear evidence, in the Maitland Mines and other places of this neighbourhood, palæozoic rocks are convertible into micaceous, chloritic, and felspathic schists, without evidence of eruptive agencies, then are the so-called igneous rocks equally so. I think it will scarcely be disputed by any who admit the re-arrangement of felspathic rocks I have contended for, that causes by which such re-arrangement was made, may have effected the original conversion of sedimentary into crystalline rocks. We have in this province a rock which has been pronounced decidedly igneous by the highest European authorities; it is the claystone-porphyry of Bain. Yet its position among the other rocks is, in many respects, just that of the quartzite; and, like the latter rock, its individual beds and its minor masses are conformable with the stratified rocks, while in ranges many miles in length, it crosses the strike of the strata, generally at an angle of about 30°. This fact was first demonstrated to me by Mr. Pinchin, a gentleman who has made many interesting observations on the geology of this country.

The sections of the Zeurberg, of Van Zonder's Plain (given above) on the Graff Reinet road, together with a somewhat imperfect recollection of that of Graham's Town, had led me to believe that the relation of the porphyry to the slate was constant. It is now evident that I was in error here. The fact of the masses of the porphyry crossing the slate without disturbing it seems to me greatly to strengthen my views as to its metamorphic origin by rendering the hypothesis of Messrs. Bain and Wylie untenable. The former gentleman supposed that the porphyry had been poured over the surface of the strata as liquid lava. Mr. Wylie referred its origin to volcanic action, producing ash, which was deposited at the bottom of the ocean, and formed this igneous-like rock with its contained granite pebbles and fragments of rock. The fact of the direction of its masses being at an angle of 30° with the strike seems to me to be incompatible with either of these hypotheses. The ranges of porphyry, like those of quartzite, die out and reappear. The normal position of the porphyry appears to be as in fig. 4, but I have seen it placed as in figs. 5 and 6 :—

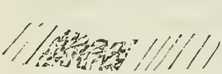


Fig. 4.

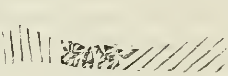


Fig. 5.

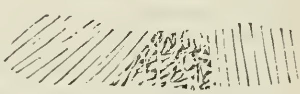


Fig. 6.

The character by which we all agree to recognize this rock is the presence of masses of quartz and granite of various sizes with occasional fragments of slate and other rocks. Sometimes these masses are as much as fifty pounds in weight, at others they are so minute as to be scarcely recognizable by the naked eye. In a recent journey to Paardenpoort I met with a mass of this porphyry which terminated in a vein about a foot thick, with very minute crystals. Now what is the character of the rock among which this porphyry is interposed or interstratified? It is such that no one acquainted with the two would pretend to diagnose them, save by the presence of the crystals above mentioned. Nor would the blowpipe, or even more careful analysis, so far as I am aware, enable him to do so. If then the base of the rocks differ so little, and there is evidence that no displacement has taken place in any known section (see Bain and Wylie), is it not clear that this rock has originated in slow conversion? Yet I believe whatever may be predicated of it may be equally so of granite; for it contains granitic masses in great numbers, and often of large size: besides granite, veins occupy precisely the same position among rocks which I have given reasons for believing to be the same strata in the Western Province.

But it will be seen above that I am not disposed to admit that the evident displacement of strata is at all times due to eruptive agency. I have given instances, on a very small scale, in which I feel sure it is not so. I hope ere long to be able to show that the infiltration of quartz from above has produced this effect, but my evidence on this subject is still somewhat defective ; I will defer what I have to say on this subject till a future period.

I have had but little time or opportunity for the microscopical studies which have done so much for the views on the nature and origin of granite which I am here advocating. I should hardly have ventured indeed to have given observations so crude as my own, but for a conviction that probably no country in the world offers greater facilities for studies of this kind than does this Colony, and more especially the district of Namaqualand, which is probably barer of vegetation and more intersected by gullies than any other country in the world not absolutely uninhabitable.

I will give a brief *résumé* of the observations which led me first to doubt and at length to abandon the igneous theory of granite, in which I was a firm believer ere I visited the Western Province of the Colony.

1. The undoubted change which rocks have undergone into quartzite and its equally evident origin in superficial and igneous agency. Mr. Darwin admits this origin of the Table Mountain sandstone.

2. The existence of beds of granite and other rocks of felspathic bases in association with sedimentary rocks in positions which it is impossible to believe they could have occupied by forcible intrusion from below. Many veins of the claystone-porphyry exceed a thousand yards in width, yet they do not in the slightest degree disturb the strata adjacent to them. At Kleinpoort I measured the slate eighteen inches from its junction with the porphyry. It dipped towards the latter at an angle of 35°, the porphyry itself having a dip in the same direction.

3. The irregular masses of granite taking the place of gneiss and not connected with the granite below.

4. The origin of prehnite and other zeolitic minerals from decomposition of igneous dykes of the Dicynodon-strata. Prehnite, as well as of quartz, is formed thus between the decomposing "boulders" of igneous rocks. Veins of carbonate of lime are often formed in the same way. Nor can I hesitate to refer the felspathic veins and irregular masses in decomposing gneiss in Namaqualand to a like process of re-arrangement. I have there seen carbonate of lime in felspathic rocks; fluor-spar mixed with epidote and felspar; phosphate of lime with felspar and quartz.

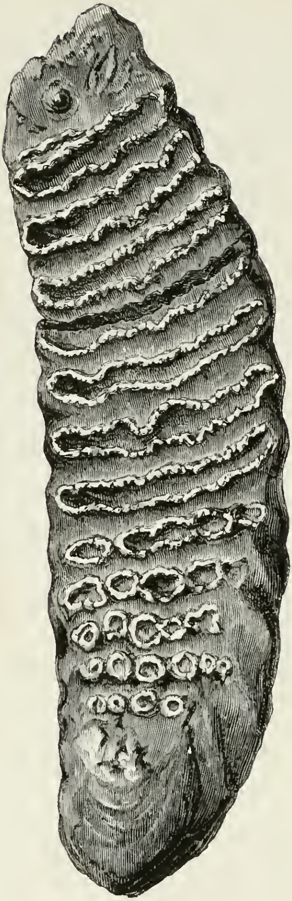
5. I have mentioned the igneous dykes of the Dicynodon-strata. They have always been referred to plutonic agency, but it appears to me that there are great difficulties in admitting such origin. They take, I believe, every direction of the compass, vary from eighteen inches to some hundreds, perhaps thousands, of yards in breadth, and some of them are probably fifty or more miles in length; they are numerous, and occur frequently from near Somerset East to the Vool River, but never, in my experience, or that of any one I know, pass the boundary of the Dicynodon-strata, nor do they disturb the rocks through which they cut in the base.

6. I have mentioned the occurrence of granite-veins conformable

with the strata among which they lie. The claystone-porphyry of Bain, appears conformable as to individual beds, while in the mass it crosses the section of the country. I have never found igneous rocks in the positions of upheaving rocks. I have repeatedly found them in positions (4, 5) where they could not possibly be so. In Namaqualand the rocks between Springbok and Concordia were perhaps more decidedly gneiss-like than in any other part of the section, except perhaps near Kok Vontein, yet I regard these two spots (the former about a mile north of Springbok Vontein, the latter two miles south-east of Kok Vontein) as the main axial lines of the country. Many facts concur to prove that whatever may have been the cause of the upheaval of strata in this country, igneous rocks have had nothing to do with it. That there are considerable difficulties about the stratification of this neighbourhood, I fully believe. That I have no clue to the satisfactory explanation of those difficulties I am obliged to confess. To mention one or two, I believe that encrinites are generally local in their distribution, that is, individual species are confined to a few beds; and that if the same species of encrinite is found in these spots, the rocks containing them may be safely assigned to the same age or near it. At the northern base of the Coxcomb* are some nearly horizontal beds of blue and ferruginous schists containing trilobites, shell-fish, and encrinites, pronounced Devonian on good authority. The strike of these rocks is north 60° west nearly, and this line of strike would pass through Cape Reciffe. The Chatty beds of shale, which are in hills continuous with those of Port Elizabeth, would nearly correspond in strike with these beds; and at Chatty two or three encrinites identical with those of Coxcomb occur. Yet at the former place the rocks dip at an angle of 45°. There do not seem to be any igneous rocks to account for this difference. At Naroos, near Uitenhage, the slaty beds are associated with quartzite, and dip at 60°–70°.

Again, the beds containing spirifers or this encrinite at Kabeljouw river's mouth, Jeffrey's Bay, have but a slight dip on the seashore; a little inland they have a greater dip, but at Hermansdorp, where the same spirifers or this of encrinite occur, they have a dip of 80° close to their junction with the quartzite. I cannot account for these things. I suppose no one in the present day would call quartzite an igneous or upheaving rock. Yet it is certainly my impression that if any rock in this country influences the change of dip in either rocks, quartzite does. Mr. Niven, the gentleman from whom I have the last fact, and who has done so much in throwing new light on the geology of this province, tells me that the quartzite, a hundred and eighty yards from the slate, dips 45°. If compelled to suggest a reason for these things, it would be, that whereas quartzite might be metamorphosed by addition of matter infiltrated, claystone, porphyry, granite, etc., might owe their origin to mere crystalline action under the agency of water, thermo-electric currents, etc. This last is Mr. Sterry Hunt's view, I think.

* Part of the Winterhock range, mis-spelt Muterhock in the abstract of my Paper.



MOLAR TOOTH OF ELEPHAS TEXIANUS (N.S.)

In the National Collection, British Museum.

S. J. Mackie del.

ON A FOSSIL ELEPHANT FROM TEXAS (*E. Texianus*).

By Charles Carter Blake, Esq.

The existence of a fossil species of true elephant distinct from *Elephas primigenius* in America has been only of late years brought under the notice of palæontologists. I have slightly alluded to the subject in the 'Geologist,' Vol. IV. p. 470. For many years remains of true Elephant have been found with those of *Mastodon* at various spots within the New World.

Cuvier ('Ossements Fossiles,' ed. 1834, vol. ii. p. 145) mentions only one species of American elephant, the remains of which had been discovered in Kentucky, Carolina, Ohio, Mexico, Louisiana, Virginia, and Maryland.

De Blainville ('Ostéographie,' Éléphans, p. 157: Atlas, pl. x.) alludes to a tooth of fossil elephant from Texas, which is apparently referable to *Elephas primigenius*. He also mentions other remains from Mexico, Mississippi, Carolina, Kentucky, Ohio, Maryland, Virginia, and Behring's Straits.

Leidy ('Nebraska Fauna,' 1852, p. 9) recognizes specific distinction between the European and American species of elephant, and terms the latter *E. Americanus*.

Humboldt ('Cosmos,' vol. i. p. 280) alludes to certain elephantine remains from the Mexican plateau, but gives no description which might identify the species.

Dr. Carpenter (Silliman's Journal, 2nd series, vol. i. p. 244) describes a collection of elephant and mastodon remains, collected by Mr. William Huff, from the banks of the Brazos river, near San Felipe de Austin (Texas), some of which are at present in the British Museum. Through the kindness of Mr. G. R. Waterhouse, I have been enabled to identify them as those originally alluded to by Dr. Carpenter.

The most complete, elaborate, and philosophical conspectus of the affinities of the Order Proboscidea has been that from the pen of Dr. Falconer (Quarterly Journal Geographical Society, 1857, p. 319, and 1858, p. 81), in which he distinctly recognizes an American species of elephant (*Euelephas Columbi*), which he says has hitherto been undescribed. He places this apart from *Euelephas primigenius*, in the same group as *E. Indicus* and *Armeniacus*, of which group he discriminates the character as having "*Colliculi approximati, machæridibus valde undulatis.*" The detailed exposition of his memoir has not been published up to February, 1862, although it was read on June 3, 1857.

Mr. William Bollaert, F.R.G.S., who has contributed original memoirs on the geography of Texas to the Geographical Society (Journal, 1851, vol. xx. p. 115), mentions the fact that he was the discoverer of a tooth of "Mastodon" from San Felipe de Austin, Texas. This tooth was carefully preserved by him, and was submitted to me in February, 1858. At that time I had not read Dr. Falconer's paper, yet from the remarkable appearance of the tooth, the conclusion that it was a distinct species of elephant, closely allied to the Indian type, forced itself on me. This opinion was confirmed by Professor Owen, and after the name of *Elephas Texianus* had been given to the species, the specimen was deposited in the British Museum, and now forms one of the most conspicuous objects in the gallery devoted to Proboscidea. Professor Owen, in September, 1858, thought fit to adopt the name of *E. Texianus* for the species, in his eloquent address to the British Association (and also in the second edition of 'Palæontology,' p. 395). From a comparison of this tooth with that already possessed by the Museum from the same locality, described by Dr. Carpenter, I think decidedly that the remains in the Museum are identical with *E. primigenius*, while the tooth discovered by Mr. Bollaert appears to belong to the distinct species of *E. Texianus* vel *Columbi*. This is the only specimen which I have seen of this type, as Dr. Falconer has not stated where the specimens are on which he described his species. He appends as a doubtful synonym, "*E. Jacksoni?*, Silliman's Journal, 1838, vol. xxxiv. page 363;" but after examination of the very bad drawings contained in that page, I cannot make any distinction between them and *E. primigenius*. The tooth of *E. Texianus* (m. 6, lower jaw) has enamel-folds much wider and much more waved and undulated than that of the *E. Jacksoni*. The canals of cement are consequently of much greater width, and the whole aspect of the tooth is much more like *E. Indicus*.

As the British Association, in their Rules for Zoological Nomenclature, have authoritatively sanctioned the principle that names not clearly defined, and likely to propagate important errors, may be changed, and as the name of *E. Columbi* lays itself open to the grave charge that it is not clear whether it is named in honour of Columbus, or because it is found in Colombia (Venezuela y Nueva Granada), I trust that this name will not be accepted. That of *E. Texianus*, founded upon a yet unimpeached geographical distinction, if it has not the advantage of published priority, yet gives a more lucid idea of the nature of the species which it indicates.

The figure by Mr. Mackie gives a better idea of its appearance than any mere verbal description. I however define it as ELEPHAS TEXIANUS, *dentium molarium* (m. 6), *colliculi undulati*, *magis remoti quam in E. Indico*. Its association with *E. Indicus* and *Armeniacus*, by Dr. Falconer, seems warranted by its legitimate affinities.

The greater width between the enamel-folds may indicate a more sapid and juicy diet than that of the larch-eating elephants of Eschscholtz Bay. The nutritious prairie-grass of Texas did not require such formidable apparatus for its comminution as was possessed by the Siberian mammoths. The indication of this species, therefore, illustrates the remarkable special adaptation of animals to external and climatal conditions, and may not be altogether irrelevant to the questions discussed by the physio-philosophers of the present day, with regard to the origin of species.

ON THE MICROSCOPICAL EXAMINATION OF SOME BRACKLESHAM BEDS.

By T. Rupert Jones, F.G.S.

In Vol. I of the 'Geologist,' at page 249, was published a paper on the preparation of sands, clays, and chalk, for microscopical purposes, under the heading of "Geological Manipulations;" and, as both pleasure and geological profit are to be obtained from the exact examination of various fossil-bearing deposits, both as to their constituents and their contents, I beg to offer you an example of the results of such an examination of some tertiary beds from Bracklesham. These notes I have had by me several years, and their shortcomings are so great in some respects that I should not send them, were it not that they may serve as a plan to some young careful observers who might feel inclined to enter upon the strict examination of some definite series of fossiliferous strata. What the series under notice is deficient of, is a statement of the exact relationship of these several deposits, examined nearly twenty years ago. I received the materials at that time from a friend who was collecting "Bracklesham fossils,"—a term which will be more definite, now that the Rev. O. Fisher, F.G.S., has indicated the exact limits of the Bracklesham formation.*

The specimens were chiefly, I believe, from Bracklesham and Selsea; but some may have been brought from the Isle of Wight. By the presence of certain fossils, however, in some of the deposits, their exact place may probably be determined. However deficient in these stratigraphical requirements the following account of the deposits may be, they will serve the purpose here intended, namely, to show young beginners what to look for in sands and clays. Instructions have been already given as to *how* such materials are to be examined, in the first volume, p. 249.

The careful microscopical examination of a good series of successive deposits, in the way that we propose, cannot but be useful both to the geologist and the palæontologist. The conditions of deposit will be elucidated by the proportions of fine and coarse materials in the beds; especially if these be traced along a considerable tract by the examination of many samples of the deposit, through its variations from clay to sand (or *vice versâ*), or in its changes from an argillaceous or arenaceous to a calcareous condition. Such variations are not always recognized with sufficient exactness by the eye or by the pocket-glass, and require mechanical, if not chemical, analysis; recourse being had to the aid of acids in determining the relative proportions of lime and other constituents. Except by careful separation in water, and patient sorting and picking, the minute shells and other fossils cannot be obtained in anything like a fair average; and year by year the Foraminifera, Entomostraca, Bryozoa, and the small

* See Report of the Geological Society's Proceedings, Dec. 4th, 1861.

fry of the Mollusca, are becoming more and more valuable as leading characteristics of strata, as our knowledge of these microzoa in the fossil and recent states advances.

Such researches as these, made on any series of deposits, whether British or foreign, must be of use, either for the improvement and correction of observations already made and published, or for the groundwork of future descriptions of strata and their fossils.

Schafhäutl, Sorby, Ehrenberg, Reade, Bryson, and others, have worked at this subject in their own several ways, and it is to be hoped that not only will these older labourers continue to work in "Microgeology" or "Clinology," as the study is termed, but that others, with equal patience and acumen, will come forward to labour in this wide and promising, but as yet little cultivated field of research.

The Results of the Examination of Five Specimens of Sands and Clays from the "Brackleshan Beds" of the Isle of Wight Basin.

No. 1. Light-blue sandy clay;* very friable; full of crushed shells.

Quantity examined, 480 grains.

		Grs.	Grs.	Proportions.
Calcareous	Shells, fragments of shells, and other fossils † ...	92	736	19
Arenaceous	Sand ‡	138	1104	29
Argillaceous	Clay §	250	2000	52
		480	3840	100

No. 2. Very light-blue, friable, sandy clay.

Quantity examined, 480 grains.

		Grs.	Grs.	Proportions.
Calcareous	Shells, etc., and fragments	23	184	5·
Arenaceous	Sand	185	1480	38·5
Argillaceous	Clay	272	2176	56·5
		480	3840	100·0

No. 3. Dark-green clayey sand; very friable.

Quantity examined, 3840 grains.

		Grs.	Proportions.
Calcareous	Shells etc., and fragments	497	13
Arenaceous	Flint pebbles	20	66·5
	Sand	2530	
Argillaceous	Clay	793	23·5
		3840	100·0

* The clays and sands in this paper are described as they appear when dry.

† The specimens No. 3, 4, and 5 being given in lots of 3840 grains, Nos. 1 and 2 (which were examined in lots of 480 grains) are given also as 3840 grains for the sake of comparison. With regard also to Nos. 1 and 2, their lists of fossils must be regarded as less perfect in relation to the other specimens, on account of the small quantity of the deposit examined.

‡ For the list of fossils, see the table further on.

§ The sands of all the lots are chiefly composed of green grains (silicate of iron?) and quartz sand. Further details respecting the relative size, angularity, etc., of the sand-grains in the several specimens ought to have been given.

No. 4. Reddish-yellow sand, very friable, abounding with large Nummulites.

Quantity examined, 3840 grains.

		Grs.	Proportions.
Calcareous	Shells* etc., and fragments	878	23
Arenaceous	Pebbles of flint, greenstone, ironstone, and brown pellucid quartz...	23	58
	Sand.....................................	2205	
	Ferruginous concretion	12	19
Argillaceous	Clay	722	
		3840	100

No. 5. Light-blue sandy clay; hard, but easily separated in hot water.

Quantity examined, 3,840 grains.

		Grs.	Proportions.
Calcareous	Shells, etc., and fragments	16	1·2
Arenaceous	Sand (very fine).........................	1296	33·8
	Pyritous concretion	70	1·8
Argillaceous	Clay	2428	63·2
		3840	100·0

TABLE OF THE FOSSILS FROM THE FIVE SPECIMENS OF "BRACKLESHAM BEDS."

No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Fish Bones.	Fish Tooth and Otolite.	Fish Bones, Teeth, and Otolite.	Fish Bone and Otolite.	Fish Bones and Otolites.
		MOLLUSCA: GASTEROPODA.		
				Murex.
			Fusus ?	
Ringicula.			Ringicula.	Ringicula.
Pleurotoma.				Pleurotoma, 2 s.
			Voluta.	
Natica.		Natica.	Natica.	Natica.
		Cerithium.	Cerithium.	
Potamis.			Potamis, 2 sp.	
Turritella.	Turritella.	Turritella.	Turritella, 3 sp.	Turritella, 2 sp.
Solarium.		Solarium ?	Solarium.	Solarium.
			Infundibulum.	
Dentalium.	Dentalium.	Dentalium.	Dentalium.	Dentalium.
			Planorbis.	
		Bulla (minute).		Bulla.

* The shells in this specimen are larger than in the other lots. In the latter the shells, etc. found in this examination were chiefly of small size, although larger shells, of course, are sometimes abundantly distributed in the mass of the beds.

hills are partly granitic; the granite is reddish, very readily decomposed, and worn by the rain and weather here and there into strange grotesque figures. There are well-defined metallic lodes in this range. East of these hills are three terraces leading down to the river. The first is the broadest, extending about two-thirds the distance, and falls twenty feet to the river. It is composed chiefly of sand; but rocks similar to those of the western rock crop out here and there. The second terrace averages about two-ninths of the distance between the range and the river: it falls about thirty feet; sometimes not more than ten or fifteen feet; at places, however, more than fifty feet. The third or lowest terrace is only one-ninth of the distance, and nearly level with the river: in fact, it is overflowed when the water is up. The river itself flows slowly, having a fall of about one foot a mile. It is at the fall or escarpment between the second and the third terrace, on an exposed face of friable limestone, that the peculiar substance referred to in this notice is found. The whitish limestone (similar to the bryozoal limestone of the Mount Gambier district) has its exposed edges excavated by innumerable burrows of wallabies, kangaroo-rats, opossums, etc., which live and breed here in countless numbers, far in the body of the rock, and the upper part of the openings of these burrows are coated with a softish-brown fetid material, which appears to be the concreted exhalations and effluvia coming from the heated interiors of these long-inhabited and thickly tenanted burrows. The concretion is thickest just within and at the mouth of a burrow, and dies away upwards on the face of the rock, just as the stain of smoke coming from a crevice is dark at the fissure, and becomes fainter and fainter up the side of the wall. This material is several inches thick, and, owing to the dryness of the climate, is not washed away by rain. In England the specimens brought over are somewhat deliquescent. It has not yet been examined chemically.

AA Wallabies' Holes. River Murray.

Fig. 2.

This curious concomitant of cave-habitats in a warm and dry climate seems worth notice as connected with the subject of bone-caves. The same country (South Australia) is likely to afford valuable information relative to the origin and early condition of subterranean caves and fissures; for the limestone of the Mount Gambier district is extensively excavated by subterranean drainage, on which the water-supply of the towns and stations is, to a large extent, dependent.

The samples of brown material referred to in the above remarks were obtained from a place on the River Murray, near the Reedy Creek (Toongell) or the Thirty-nine Sections, called Pontarra, or Green

Corner, and at Cooloodee. It is about fifty miles due-east of Adelaide, and about 35° south latitude, and 139° 20′ east longitude. I found it while making my surveys for the direct eastern line of railway from Adelaide to the River Murray (see Council Paper, No. 47, September 10th, 1858, S. A.).

The River Murray and its tributaries drain an immense district in New South Wales, Victoria, and South Australia, discharging itself into the Lake Alexandria in South Australia; thence to the sea it is navigable for 1500 miles.

[Our readers are referred also to the Journal of the Geological Society, No. 63, August, 1860, pages 252–261, for some account of the geology of the South-Australian district above referred to.—Edit. Geologist.]

CORRESPONDENCE.

The Accumulation of Cave Deposits.

Dear Sir,—Without offering any opinion on the Rev. H. Eley's speculation, in the December Number of the Geologist, on the mode of "The Accumulation of Cave Deposits," I presume it is quite safe to conclude that it could only apply, at most, to caverns which were inhabited by animals.

Now, though we have satisfactory evidence that *some* caverns—Kent's Hole near this place, for example—were the homes of carnivora, *others*, and some of them very famous, are entirely destitute of any such indications, whilst their distinctly stratified deposits were certainly due to the long-continued action of water.

Amongst the numerous caves near the sea-level which occur in the limestone cliffs between Berry Head and Mudstone Bay, near Brixham, there is one into which the sea only enters at spring-tide high-water, or during very heavy gales. It is only accessible from the sea, and is situated at the apex of a small cove, the mouth of which is a passage, probably about twenty feet wide, between two walls of limestone; within it is somewhat wider. Except at high-water, a small, steep, terraced, shingle beach lies between the sea and the mouth of the cavern. The cove is simply a gallery, at least eighty feet long, about four feet wide, in some places not more than three feet high, but commonly high enough for a man to stand erect. In fact, it is nothing more than one of the north and south joints, or lines of fracture, so common in the district, eroded into a tunnel.

A considerable drip of water, apparently free from earthy matter, enters through the roof.

When recently visiting it, I found the floor, consisting of fine sea sand, more or less covered with fresh seaweed, which was most abundant at the inner end. About halfway in, I picked up several disjoined bones, probably parts of the same animal, undoubtedly a terrestrial mammal, and, judging from the state of the epiphyses, a young individual. I have still some of them by me. With one exception they are quite free from all marks of abrasion.

The sea had also carried in some evidences of the existence of man;

amongst other things I remember a portion of a tin kettle and a fragment of a basket, of the coarse kind used on board colliers and other ships.

Here, then, is a cavern which the sea is at present filling, and in which it is depositing relics of man and portions of terrestrial mammals, but not, so far as I could discover, any marine organism, excepting the seaweed. Probably a careful search might have detected some small shells and other sea-offerings amongst the weeds, but I certainly saw nothing of the kind, nor were there any of the larger mollusks so constantly cast up on our beaches. There appears no reason, *à priori*, why some caves belonging to earlier periods may not have received their contents in a similar manner.

Again, those who have visited the Cheddar Cliffs, in Somersetshire, probably remember that a considerable body of water issues from the foot of the right-hand cliff, not far above the village of Cheddar. This stream commences its subterranean journey about two miles off, where it enters a "swallet."

It is scarcely possible to believe that it fails to introduce specimens of the natural history of the district into this cavern, or that it does not deposit organic relics, together with mud and stones, in at least some of the sheltered nooks and recesses which probably occur along its course of fully two miles.

I have no doubt that, at least, one of the celebrated caves of this county was in this way furnished with the materials which have rendered it famous.

I am far from believing that the history of any cavern can be regarded as generally typical. Neither of the agencies above described could have produced the phenomena observed at Orestone, near Plymouth, where, in all probability, the fossils and the materials in which they were inhumed found a passage through an open fissure into the cavernous interior of the limestone.

It would not be safe to generalize from any individual case, whether it be Kent's Hole, Windmill Hill Cave at Brixham, the caverns at Orestone, or a dirty dog on a study hearth-rug.

I am, yours, etc., WM. PENGELLY.

Lamorna, Torquay, December 14th, 1861.

Northampton Sands.

DEAR SIR,—In replying to Dr. Wright's communication in the last number of your excellent periodical, I offer him my apologies. The origin of my mistake was, in carelessly reading that part of Mr. Aveline's 'Memoir on the Geological Survey of a part of Northamptonshire,' where he speaks of the confusion that formerly existed with regard to these sands.

These beds have been assigned to the Upper Lias, although not by Dr. Wright, and are so coloured on more than one geological map. For instance, in Reynolds's 'Geological Atlas,' lately published under the revision of Professor Morris, all the country over which the Northampton sands are so well displayed has been coloured, with the *Lias*, brown, a mistake which should be avoided if a second edition of that neat and otherwise useful little work is contemplated.

The fact is, no one knows exactly where to place or with what to class these sands. Lias they assuredly are not. Mr. Aveline considers them to be equivalent to the Stonesfield Slate of Oxfordshire. This seems likely, both from their position and their organic remains. But a deal yet remains to be done with them; they have yet to be accurately traced, searched, and studied. Strata which yield, as they do, such valuable iron-ore, demand attention and examination.

Yours very truly,
JOHN H. MACALISTER.

Oxford, January 1st, 1862.

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

GEOLOGISTS' ASSOCIATION.—The ordinary monthly meeting was held on Monday, December 2nd, at 5 Cavendish Square. The Rev. Thomas Wiltshire, M.A., F.G.S., President, in the chair. The following papers were read:—"On two beds of re-deposited Crag Shells in the vicinity of Yarmouth, Norfolk," by C. B. Row, Esq., F.G.S. "On a Newly Discovered Outlier of the Hempstead Strata on the Osborne Estate, Isle of Wight," by Dr. E. P. Wilkins, F.G.S. "On the Exchange of Fossils among the Members," by A. Bolt, Esq., A.A.

Professor Tennant exhibited several specimens of gold recently forwarded from Nova Scotia to this country. He read extracts from a Report which has made by Mr. Howe to Lord Mulgrave, the Governor of the Colony, in September last, from which it appears that the gold-discoveries made in the colony in 1860 were unimportant, the gold being found in quantities so small as not to afford a satisfactory return for the labour of seeking for it. The exitement had accordingly subsided. Last March, however, a man accidentally discovered a piece of gold among the pebbles at a brook; this led to further investigation, and it is now generally believed that gold in abundance exists in the colony within an easy distance of means of transport, and Mr. Howe considers that the Government will be warranted in assuming that at the localities where the chief working has been hitherto carried on, viz. Tangier, Lunenburg, Lawrencetown, and Lake Thomas, gold-mining will be permanently established as a new branch of industry, tempting to the capitalist and attractive to the emigrant. The gold is found in quartz veins and in the sand on the shore. Specimens of gold in the matrix, and some of the gold grains found in the sand were exhibited, as also two ingots of pure gold cast from that discovered in the above-mentioned workings.

Mr. Rickard exhibited a machine recently patented, the object of which is to render peat available as fuel, to the same extent as coal, at a greatly reduced price.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.—*November 26th*, 1861. J. P. Joule, LL.D., President, in the chair. A Paper was read by Mr. E. W. Binney, F.R.S., entitled "Additional Observations on the Permian Beds of South Lancashire." This was a continuation of two previous papers read before the Society. Since that time the author had made further observations on the Permian strata at Heaton Norris, near Stockport; Medlock Vale, between Ashton and Manchester; Chorlton-upon-Medlock, and Ordsal near Manchester; and Skillaw Clough and Bentley Brook, near Newburgh, in the west of Lancashire.

At Heaton Norris, in the sand delf of Mr. Howard, near the railway station, the lower New Red Sandstone was seen dipping to the south-west at an angle of 25°. This was succeeded by red and variegated marls having a similar dip. These last-named strata were overlapped by the Trias, which dips to the south-west at an angle of 12°.

At Heaton Mersey the following section was met with:—

	Feet.
Trias	45
Permian—Red and varigated marls containing limestones	129
Lower New Red Sandstone grooved	402
	576

The Permian beds were cut off by a fault near the railway station at Heaton Norris (first noticed by Mr. Hull, of the Geological Survey), which brought in the Trias. This rock occupied the district between that town and Goyt's Hall, in the Marple valley, where the lower part of the middle coal-measures was seen in nearly a vertical position.

The author considered Mr. Howard's sand delf to be a likely place for ascertaining whether a coal-field worth working existed under the town of Stockport.

The next was a section made by Mr. John Wood, at Medlock Vale, between Waterhouses, near Ashton-under-Lyne, and Manchester. It was as follows:—

	Feet.	In.
Drift	26	0
Trias	23	0
Permian—Red marls, with beds of limestone and five beds of gypsum	246	3
Lower New Red Sandstone	375	11
Coal-measures about	90	0
	761	2

What these coal-measures were, whether above or under the Bradford Four-feet Mine, it was at present impossible to say; but it was to be hoped that some mine would be met with to enable us to determine the value of the great tract of coal-measures lying between Ashton-under-Lyne, Oldham, Middleton, and Manchester. Mr. Wood had done more than any other gentleman to clear up this point, and it was to be desired that he should meet with a good seam of coal, both for his own sake and that of the public.

The third section mentioned was at the sugar-works of Messrs. Fryer and Co., in Chester Street, Chorlton-on-Medlock, Manchester. The following beds were there met with:—

	Feet.
Trias	114
Permian—Red marls with limestones	237
Coarse red sandstone with pebbles	45
Coarse red sandstone	24
Coal-measures, consisting of red shaly marls and limestones (Ardwick)	126
	546

The limestones in the last-named strata contained specimens of *Microconchus carbonarius* and scales of *Palæoniscus*, which clearly proved them to be similar beds to those of the upper coal-field at Ardwick, to which they bear every resemblance in physical character.

The occurrence of coal-measures on the south side of the city of Manchester is quite new and of great importance, showing that such strata at places are met with under Permian and Trias deposits much nearer the surface than was previously suspected, and where the upper rocks gave no evidence of their proximity. The above bore has proved beyond doubt that a band of coal-measures lies under the south of Chorlton-on-Medlock, and possibly extends to Heaton Norris, being probably brought up by the great Pendleton fault, which most likely passes through the south of Manchester and joins the fault seen near the railway station at Heaton Norris previously alluded to.

In the fourth section, at Ordsal, Messrs. Worrall found the Trias beds four hundred and sixty feet in thickness without going through them. At the bottom of the bore the water became so salt that they discontinued the work, it being no longer fit for dyeing and such-like purposes. This is the first instance, to the author's knowledge, where salt water has been met with in the Trias near Manchester.

The fifth and sixth sections were at Skillaw Clough and Bentley Brook, to the north of the Newburgh station on the Manchester and Southport railway. These were some time since discovered by Mr. E. Hull, of the Geological Survey, and described shortly by that gentleman in the sheet explaining the map of the district. Further particulars were given of the details of both sections, and an analysis of the limestone was produced, which showed it to differ in its chemical characters from the thin ribbon-bands found in the Permian marls near Manchester, Patricroft, Astley, and Leigh; it was very like the yellow magnesian limestone found at Stank, in Furness, North Lancashire. Probably it might prove to be a different bed, and more like the great central deposit of magnesian limestone of Yorkshire than the thin beds previously alluded to.

December 24th, 1861.—J. P. Joule, LL.D., President, in the chair. Mr. Binney stated that many years since he had communicated to the Society a description of some markings on the surface of the Kerridge flags. He afterwards published, in Vol. X (New Series) of the Memoirs, a Paper on similar markings, found in the Upholland flags, near Wigan, and attributed then to the burrowing of an animal similar to the common lug-worm of our coast, the *Arenicola piscatorum*. Similar holes have since been found in rocks of various ages, from the Cambrian upwards.

The position of the Kerridge flags is, probably, one of the best ascertained in whole coal-field. It is in the lower division above the millstone grit. In the lower coal-field there are two main beds of flagstones: the first, or lower, the Rochdale series, under the "rough rock;" and the upper, or Upholland or Kerridge series, above the same rock, the chief workable beds of the lower coal-field of Rochdale and other districts, often termed the "mountain mines," lying midway between these two flag-deposits. This series of coal is now, and has been for many years, wrought under the Kerridge, flags so as prove beyond doubt the position of the latter. Some discussions have lately taken place at Macclesfield as to whether the Kerridge beds were Permian or Carboniferous. No one who ever saw Permian beds, could ever for one moment suppose Kerridge flags to belong to those strata. It is possible that Permian beds may exist in the low district lying between Kerridge and Macclesfield, as they have been met with at Hug Bridge on the south, and Norbury Brook on the north, but up to this time they have not been proved to be there.

Considerable interest has been excited by the discovery of what were supposed to be the foot-marks of some animals on the surface of the flags. He had been induced to make two journeys to Kerridge for the purpose of examining them; but although plenty of worm-holes and ripple-marks are to be found on the surface of the Kerridge flags, as yet he had seen no tracks of animals upon them.

Mr. Edward Hull, B.A., called attention to instances of glacial striations recently discovered by Mr. G. H. Morton, at Liverpool. During a recent visit to that town in connexion with his duties on the Geological Survey, Mr. Hull was kindly conducted by Mr. Morton to the spots where the striæ are visible. One of these is at the south, the other at the north side of the town, and at the latter the extent of surface exposed is several hundred square yards. The rock-surfaces had been protected by a thick coating of boulder clay, which has been removed for brick-making. It is owing to the protection thus afforded to the rock that the striations are preserved in all their original freshness. The rock belongs to the New Red Sandstone, and is a moderately hard reddish-brown and yellowish building-stone. There are two systems of striæ, the primary one ranging N.N.W., the secondary nearly east and west. Of the latter, the markings are comparatively unimportant, but are very clear and sharp. The primary striæ run in remarkably straight lines—in the form of deep groovings and scratches, and the whole surface of the sandstone is worn down to one uniform gently-sloping plane.

It appeared evident, from the directions of the striæ, that they had been produced by icebergs coming from the north, in all probability from the Cumberland mountains, where glaciers are known to have existed during the period of the boulder clay, or rather earlier. The secondary groovings might have been produced by bergs coming from North Wales, but this appeared very problematical. The interest attached to these cases of glaciation was stated to arise from their position at so great a distance from the Cumberland range. In the immediate neighbourhood of these mountains, as also in that of North Wales, ice-moulded surfaces have frequently been observed, but never before on the New Red Sandstone of Lancashire or Cheshire.

Mr. E. W. Binney referred to the existence of similar striations on the Carboniferous limestone of Great Orme's Head, where the groovings were found to range northward, or outwards from the mountains of the interior. He also noticed the distribution of the Shap granite, blocks of which he had lately seen on the high Silurian and Carboniferous ranges to the south and south-east of Shap Fell.

Mr. Brockbank stated that, on the high lands of Yorkshire and Derbyshire, he had observed erratic blocks which could be traced to their northern sources.

Mr. Hull said, it had been shown, by a large number of facts, that the direction of the erratic blocks of the Drift period was from north to south, so that there must have been some predominating influence in operation, either prevalent winds, or, more probably, oceanic currents, tending to impel southward the icebergs and rafts which were the vehicles for the transportation of the erratic boulders and pebbles.

Geological Society of London.—*January* 8, 1862.—Sir C. Lyell in the chair. The following communications were read:—1. "On the Carboniferous Limestone of Oreton and Farlow, Clee Hills, Shropshire." By Professor John Morris, V.P.G.S., and George E. Roberts, Esq. With a Note upon a new species of *Pterichthys*, by Sir P. de M. G. Egerton, Bart., M.P., F.G.S. The rocks described in this paper are a series of thin beds of limestone and sandstone lying between the Old Red Sandstone of South Shropshire and the Millstone Grit which forms the basement of the Titterstone Clee coal-field. In consequence of the opening of new quarries and the cutting of a roadway through the Farlow ridge transversely to the strike of these deposits, the authors were enabled to add somewhat to the description of the locality given in 'The Silurian System.' The series of deposits from the Old Red "cornstone," upwards, was shown by them to be:—1. Laminated yellow sandstones, with pebble-beds and sands. 2. Bright-yellow sandstones, containing *Pterichthys*. 3. Brecciated yellow sandstones, pebble-beds, sandy layers, and laminated sandstones. 4. Sandy and concretionary limestone. 5. Grey oolitic limestones, containing palatal teeth of great size. 6. Clays, with ferruginous bands. 7. Shaly crinoidal limestones. 8. Clays with limestone concretions, and shaly limestones. Against the last-mentioned bed the Millstone Grit rests unconformably. These beds thicken out at Orcton, a mile east of this Farlow section, and are there extensively worked for various economic purposes, the oolitic limestones, locally termed "jumbles," being used for decorative purposes under the name of Clee Hill Marble. In describing the physical conditions of the localities, mention was made of the "Mole river," which, losing itself at the west end of the ridge, takes a subterranean course nearly parallel with its axis, and reappears at its lower end, a mile distant. An interesting fact was communicated to the authors by the Rev. J. Williams, of Farlow, of an accidental accumulation in the hollow of its inlet of a body of water estimated at 1,635,000 cubic feet, the whole of which was carried away in forty-eight hours by the sudden clearance of the channel. In describing the palæontology of these rocks, the authors specially drew attention to the fortunate discovery, in the yellow sandstone of Farlow, of *Pterichthys macrocephalus* (spec. nov., Egerton), made while reducing the thickness of a large ripple-marked slab sent them by Mr. Weaver Jones in illustration of the physical conditions of the deposit. This *Pterichthys* proving identical with the fragment previously found in the Farlow Sandstone by Thos. Baxter, Esq., F.G.S., they attached to the paper a descriptive note on that fossil, by Sir Philip Egerton, in which the Farlow *Pterichthys* was contrasted with that of Dura Den, and additional proof given of the identity of the genera *Pamphractus* and *Pterichthys*. In addition to pterichthyoid remains, scales of two species of *Holoptychius*, one probably new, had been found by them. The richness of the overlying limestones in palatal teeth was shown by a fine series of examples, amongst which *Orodus ramosus*, of unusual size and in perfect condition, and an undescribed *Pœcilodus*, of great magnitude, were most conspicuous. Other genera represented were *Helodus*, *Psammodus*, *Cladodus*, *Cochliodus*, *Petalodus*, and *Ctenoptychius*. Ichthyodorulites, of large size and rich ornament, chiefly belonging to the genera *Ctenacanthus* and *Oracanthus*, accompany these teeth. The notices of the invertebrate fauna given by the authors proved the assumed lowness of the Orcton Limestones in the Mountain Limestone series—the zone of *Rhynconella pleurodon* being well marked, crinoidal and bryozoan remains abundant though fragmentary, and corals nearly absent. A large series of *Pterichthyes* and of rock-specimens were exhibited in illustration by Mr. George E. Roberts; and a collection of palatal teeth was liberally sent for exhibition by W. Weaver Jones, Esq., of Cleobury Mortimer, and by Edward Baugh, Esq., of Bewdley.

2. "On some Fossil Plants, showing Structure, from the Lower Coal Measures of Lancashire." By E. W. Binney, Esq., F.R.S., F.G.S. After noticing the views taken of the structure of *Lepidodendron* by Hooker and others, the author proceeded to describe three portions of calcified stems, Lepidodendroid in external appearance, two of which exhibit in section a central axis composed, not of cellular tissue, but of large, transversely barred, hexagonal vessels. These two specimens the author refers to a new species, *Sigillaria vascularis*. The third specimen differs from the others in the absence of the thin radiating cylinder of barred vessels around the central axis; this he terms *Lepidodendron vasculare*. Microscopical preparations and photographs of sections were supplied by the author.

3. "Supplemental Notes on the Plant-beds of Central Asia." By the Rev. S. Hislop. In a Letter to the Assistant-Secretary. Mr. Hislop, in noticing the discovery of more remains of plants, insects, and fishes at Kota on the Pranhita, stated that he certainly now thought that the ichthyolitic beds of Kota (probably Lower Jurassic in age) are higher in relative position than the plant-sandstone of Nagpur, which, with the Sironcha sandstone underlying the Kota limestone, belong to the Damuda group. He remarked also that, in his opinion, the *Tæniopteris* of Kampti would prove that the Damuda and Rajmahal groups cannot be widely separated.

NOTES AND QUERIES.

Mammalian Remains.—Fractured bones of *Bos primigenius* have been found on the road between Kelvedon and Coggesham, Essex, by W. H. Thelwall, Esq., who has submitted them to me for identification.—Yours faithfully, Charles Carter Blake.

Fossil Cocoons of Leeches.—Dr. Gergens, of Mayence, has lately suggested that the so-called fossil eggs of snakes, found in some of the freshwater deposits of Germany, may be fossil cocoons of leeches (N. Jahrb. 1861, p. 670). Under these circumstances it may be worth while for those who possess specimens of the egg-like bodies found in the freshwater strata of the Isle of Wight (and which have been thought to be either coprolitic or the eggs of *Bulimus*, or of freshwater tortoises), to re-examine them, and compare them with the sponge-like oval cocoon of the common leech. Mr. F. E. Edwards figures several of these oviform bodies in his Monograph on the Eocene Gasteropods, published by the Palæontographical Society.—Hirudo.

Hampshire Basin.—Sir,—Would you kindly solve the following questions for me, to which I have not been able to find any satisfactory answers in the text-books which are commonly available?

1. What was the extent of the Hampshire Basin; and when did the upheaval of the present range of chalk hills to the north and west take place; and did the sea, which covered the present New Forest district, ever wash against these latter?

2. When did the severance of the line of chalk between Ballard Head, in Dorsetshire, and St. Christopher's Cliff, in the Isle of Wight, take place?

3. Could the following animals be said to be coexistent at any period of the Middle Eocene formation (and what?),—*Dichodon cuspidatus, Hyænodon, Paloplotherium annectens*, and *Spalacodon?*

4. What was the climate of the country when the freshwater deposits took place at Hordell?—Your constant reader, W. B. H., Lymington.

1. The Hampshire basin was not an isolated area, but continuous with the London basin; the deposits in the two areas differing according to depth of sea, presence of rivers, etc. The uprise of the chalk hills took place probably during some portion of the Pliocene period. The New Forest district, as now existing, has been covered either by the sea or by a lake in the Pleistocene period. 2. In the Pleistocene period.

3. Yes; during the Middle Eocene period *Paplotherium*, *Palæotherium*, and others, existed with *Hyænodon*, in the western European area.

4. Probably much warmer than at present—subtropical.

NOTICE OF HUMAN REMAINS IN CORNWALL.—Dear Sir,—While reading the Autobiography of Mary Anne Schimmelpenninck, I met with the following passage in one of her letters, which, as bearing on a most interesting subject at the present time, deserves to be further investigated by those of your readers who reside near the place mentioned, in order to discover the truth of her statement.

In describing her journey from Truro to Falmouth, she says, "Near Gwennap is a place worth seeing, called Carnon Stream Works. Instead of mining for tin, they here direct streams over the sides of the hills, so as to wash down the loose tin, which is here termed 'stream tin.' Here have been found many interesting antiquities,—a pickaxe made of elk's-horn, flint arrow-heads, and *human skeletons*,—buried beneath several strata (alternately of fresh-water and marine shells), twenty-four feet from the present surface of the ground." This was written in 1825.

Yours truly, R. D., Berwick-upon-Tweed.

THE COAL TRADE.—The total shipments of coal foreign and coastwise last year are estimated at 19,161,615 tons, as compared with 18,159,488 tons in 1860, and 17,218,972 tons in 1859. Newcastle last year shipped 1,916.588 tons of coal and 128,773 tons of coke oversea, and 2,345,017 tons of coal and 20,972 tons of coke coastwise; Sunderland, 1,023,495 tons of coal and 39,319 tons of coke oversea, and 1,881,299 tons of coal and 268 tons of coke coastwise; the Hartlepools, 595,674 tons of coal and 18,566 tons of coke oversea, and 1,402,258 tons of coal and 6,508 tons of coke coastwise; Liverpool, 650,106 tons of coal and 9,582 tons of coke oversea; Cardiff, 1,123,557 tons of coal and 5,153 tons of coke oversea, and 880,961 tons of coal and 7,976 tons of coke coastwise; Swansea, 411,377 tons of coal and 1,398 tons of coke oversea, and 190,612 tons of coal, 53 tons of coke, and 51,902 tons of culm coastwise; Newport, 213,585 tons of coal and 22 tons of coke oversea, and 711,225 tons of coal and 2,040 tons of coke coastwise; Shields, 56,589 tons of coal and 2,133 tons of coke oversea, and 23,746 tons of coal coastwise; Blyth, 147,440 tons of coal oversea, and 133,065 tons of coal coastwise; Seaham, 60.837 tons of coal oversea, and 620,465 tons of coal coastwise; Middlesborough, 106,506 tons of coal and 37,159 tons of coke oversea, and 198,958 tons of coal and 3,082 tons of coke coastwise; Hull, 129,849 tons of coal and 422 tons of coke oversea, and 10.262 tons of coal coastwise; Llanelly, 106,376 tons of coal and 4,797 tons of coke oversea, and 262,201 tons of coal and 11,922 tons of culm coastwise; Glasgow, 81,171 tons of coal and 1,542 tons of coke oversea; Port Glasgow, 16,852 tons of coal oversea; Greenock, 65,245 tons of coal and 899 tons of coke oversea; Grangemouth, 71.045 tons of coal and 377 tons of coke oversea; Alloa, 58,635 tons of coal and 37 tons of coke oversea, and 9,334 tons of coal coastwise; Whitehaven, 2,498 tons of coal oversea, and 182,146 tons of coal and 1,203 tons of culm coastwise; Maryport, 374,801 tons of coal and coke coastwise; St. David's, 55,898 tons of coal oversea, and 5,166 tons of coal coastwise; Ardrossan, 35,800 tons of coal oversea, and 79,906 tons of coal coastwise; Charlestown, 60,305 tons of coal oversea, and 53,632 tons of coal coastwise; Inverkeithing, 24,499 tons of coal oversea, and 8,295 tons of coal coastwise; and Borrowstonness, 28,645 ton of coal and 234 tons of coke oversea, and 53,476 tons of coal coastwise.

TURTLE REMAINS IN THE UPPER GREENSAND.—The phosphatic nodules of the Upper Greensand of Cambridge are well known to geologists from their extensive commercial use in the manufacture of super-phosphate of lime for agricultural purposes. The nodules have been secreted in or around various organic remains, many of which, such as the bones, were often, probably, broken up before the concretion of the phosphatic matter around them, and both they, and the nodules subsequently, have apparently been not uncommonly subjected to a considerable amount of rolling and degradation. Numerous kinds of shells are common in these nodules, as are bones of pterodactyles and other reptiles. Our attention has lately been drawn to very numerous fragmentary remains of turtles, consisting chiefly of the crania and lower jaws, with numerous fragments of the carapace, ribs, and many vertebræ. The predominance of the skulls and lower jaws in the collection we refer to, which was made by Mr. Farren, of Cambridge, and has just been purchased by Mr. Gregory, is probably the mere accidental result of the collecting of what might be deemed saleable specimens, or that these portions being the most readily recognized, attracted attention, while the other fragments of the limbs and body, more obscure in their aspect, were left in nodule-heaps. Professor Owen has made out distinctly, not less than four species, namely,—*Chelone sulcimentum*, *C. altimentum*, *C. uncimentum*. and *C. depressimentum*. But the point to which we want to draw attention is, the district and the land-shores on which these turtles lived. The Upper Greensand is a marine deposit, and the beds at Cambridge seem closely allied to the grey chalk, especially as that member of the cretaceous group appears developed in Kent and Sussex, and therefore should have been formed under some considerable depth of water.

Now all the Cheloniæ are of littoral habits, and as these greensand-nodules, like the phosphate-nodules from the Gault and Lower Greensand, and all the other deposits from which we have seen them, frequently have oyster and other shells attached to them, it would seem that they had been brought to a hardened state before they were imbedded in the strata where we now find them. We ought therefore to look to some of the older formations as the land whose coasts they inhabited.

The turtles of the Wealden have never been properly collected, and it is with a view to inducing some one to take up the search for them and their comparison with these Upper Greensand fragments, that we have published this note; for to the Wealden lands *à priori*, it is that we should be inclined to turn for the shores on which these ancient turtles lived, and from which their concreted remains were probably washed down by the tides and currents into the lower depths of the *Wealden* sea, where some portions of the Upper Greensand were contemporaneously being deposited.

Fossil Feather.—From the lithographic stone of Solenhofen, in Bavaria, Hermann von Meyer has obtained a fossil impression of a feather, on the two opposite surfaces of a split slab. This he cannot distinguish from the feather of a bird. This interesting relic will be described and figured in the "Palæontographica."

Devonian Fossils.—*Errata*. In the title, *for* Geological *read* Geographical. Page 19, line 14, *for* Devonshire read Devonian. Page 20, line 14, *for* era *read* area. Page 20, line 5 from bottom, for Table IV. *read* Table V.—W. Pengelly.

FOREIGN CORRESPONDENCE.

Professor Schrœtter communicated to the Imperial Academy of Sciences of Vienna, on the 17th October, that a litha-mica, containing more than three per cent. of rubidium, cæsium, and lithium, has been lately found in Saxony, and that samples of it had been sent to Professor Bunsen, at Heidelberg. Mr. Seybel, the owner of an extensive chemical manufactory at Liesing, near Vienna, has lately procured a large quantity of lepidolite from Rozena, Moravia, and of lithium-mica from the Zimwald, Bohemia, for the preparation of the three metals above-mentioned. From the results of Professor Peters' recent examination of the miocene strata of Hidas, in southern Hungary, and from the observations made by M. Hantken on the foraminiferal strata in the Cerithian limestone series, near Buda-Pesth, there appear additional proofs of the existence. in Hungary, of marine deposits containing a fauna analogous to that of the Cerithian strata in the older marine deposits of the Vienna basin.*

Dr. Lorenz has given the following information regarding the Gulf of Quarnero :*—"This gulf, situated at the north-east end of the Adriatic, between the Illyrian and Hungarian shores, a square degree in extent, receives uniformly cold freshwater currents, which impart to the waters of the gulf a temperature below the average of that of the Adriatic. The atmospheric currents affecting it are either regular or casual; among the latter the 'Bora,' coming from the north, after having passed over the south Alpine ranges, is remarkable for its impetuosity and low temperature. The difference between high and low water, as observed during five successive years along the whole coast from Quarnero to Lesina, does not exceed a foot and a half. The tide rises only once in twenty-four hours, loses two days every month, and does not seem to be more influenced by lunar phases than by winds or other transient causes. The drift-currents depend chiefly on the atmospheric pressure and currents obtaining within the narrow channels separating the islets from each other; and, by taking into account the existing meteorological condition, they may be easily known and foreseen; a great advantage to the vessels navigating this small archipelago.

"The vegetable organisms in the Quarnero are distributed among one super-littoral and four marine zones, having their maxima at the respective depths of ½, 8, 20, and 45 fathoms. The higher these zones the more they number new forms and bear a characteristic type. The *Diatomaceæ*, analogous in this respect to the animal organisms, follow a different rule of distribution, their new forms becoming more numerous with increasing depth. The habitats of nearly 600 species of *Algæ* (among which are above 300 *Diatomaceæ*) have been ascertained.

"The 700 animal species (*Infusoria* excepted) which have been observed in the Quarnero (the greatest depth of which is not above 50 or 60 fathoms) differ in their distribution from the vegetables; the maxima of their submarine zones having the depths of ½, 4, 15, 30, and 50 fathoms.

"The organic character of the Adriatic shores is different from the facies of other less circumscribed seas, chiefly in consequence of its anomalous tides; a circumstance to be specially considered if ever artificial oyster-breeding should be intended, such as already exists on the Atlantic coasts of France under quite different physical conditions.*

"A small colony of 'Boreal' forms, characterized by the presence of *Nephrops Norvegicus*, has taken possession of the depths wherever springs of cold freshwater, rising from the bed of the Gulf, have afforded them favourable conditions of existence. If compared with other marine faunæ, the fauna of the Quarnero shows notable differences only in its higher zones. At 30 fathoms depth it is nearly identical with the Baltic fauna of the same zone; and at 50 fathoms the faunæ of all European seas may be regarded as being quite uniform in character."

* Proceed. Vienna Imp. Acad., Oct. 10, 1861. Proceed. Imp. Acad. Sciences, Vienna, Nov. 7 and 14, 1861. See the 'Moniteur,' 1861, No. 97. (Communicated by Count Marschall.)

REVIEWS.

The Alps; or, Sketches of Life and Nature in the Mountains. By H. Berlepsch. Translated by the Rev. Leslie Stephen, M.A. London: Longman and Co., 1861.

A charmingly written and entertaining book ought a book about the Alps to be; and so is M. Berlepsch's 'Sketches of Life and Nature in the Mountains.'

The Alps are amongst the sublimest results of terrestrial physical power, and there are but few men who know them in their real and full majesty. That unveils itself least of all where the broad military roads stretch over passes and anticlinal "saddles," or where the scenes of daily life are busy at the footstool of the giant mountain edifice, that towers to the skies above. You must, as M. Berlepsch says you must, penetrate into the secrets of the hidden world of mountains, into the solitude of closed gorges and valleys, where man's power of cultivation sinks powerless as he comprehends the weakness of his efforts against the majesty of Nature in the Alps. "You must climb above the ruins of a primeval world, and press through labyrinths of glacier and wastes of ice into the temple sanctuary, where it strikes up freely and boldly into the sky before your wearied eyes. Then you will encounter the indescribable splendour of the Alpine world in all its vastness, till you are ready to sink under the thought of its awfulness; and when you have recovered from your first impression, when in sight of the gigantic masses, you have opened your heart, and prepared it to receive still nobler revelations, then question boldly those mausoleums of immemorial time: ask them what hand raised them from the depths of eternal darkness into the kingdom of light; consult the rocky leaves of this stone-chronicle, for the history of their creation and the end of their existence. The vast dead masses will become alive for you, and a view will open for you into the endless cycle of eternity." With the eye and understanding of a geologist look upon those enormous rock-masses. See the strata upheaved and contorted, bearing the relics of primeval seas, buried in the fine dust of earth, and the ground-down waste of former lands; and ponder on the hundreds of thousands of years that those old silts and muds lay beneath the waters of the cold transparent sea.

"Who could have witnessed those convulsions and outbursts, when in the central Alps, the very inmost kernel of the gigantic mountain fabric, the granite, gneiss, and crystalline schists were forced up from the depths of the earth's crust, pierced by the sharp masses of the hornblende rocks, and spread out like a fan? How powerless would be the wildest natural convulsions we know, how insignificant the earthquakes, storms, volcanos, and landslips of the present time, by the side of that catastrophe, when the Alps took their present shape! Our understanding has absolutely no standing-point from whence to form a conception, even faintly answering to those moments when a world was shattered. . . . Those majestically aspiring masses which run free and bold into the clouds, like gigantic obelisk spikes, as the lone and inaccessible Matterhorn, 17,405 feet in height, the dazzling snow pyramid of the Dent Blanche, 14,322 feet, or the nine-pointed diadem of the Monte Rosa, 15,217 feet, which never can have been protruded through the earth's crust in their present shape, and can be nothing but isolated ruins of the primeval mountain fabric. What fearful ages of destruction must there have been, to allow the intervening masses now vanished, to be torn away, and to sink, probably, into the depths whence they rose? For a number of proofs show that no influence of weather on these towers of rock can ever have so modelled and gnawed them down. . . .

"Most of what is called granite in the central Alps is granitic gneiss, called in the people's language 'Gaisberger,' because the highest mountains climbed by the goats (*Gaisen*) are formed of it. It is the substance from which the atmospheric influences carve those strange towers of rock and picturesque ornaments, which in Chamouny are significantly called Aiguilles, from their sharp points. From this so-called 'primeval mateterial' are formed the wondrous spikes of stone which ornament the summits of different mountains, or strike up here and there like outposts through the far-stretching wastes of névé. We should see many more of these slender rock 'needles' if many of them were not engulfed in the perpetual snow. Here the Achilles-heel of the apparently indestructible 'urgestein' betrays itself. Gneiss is, as already stated, of stratified tabular structure. In the elevation of the Alps, the strata of gneiss were raised, and often placed vertically on the edges of the fracture, as the immediate envelope of the granite. The mass must have been of various hardness at different places. At any rate, whilst particular parts have withstood the action of the weather without injury, others have been overthrown, gnawed into, and destroyed by the atmosphere to such an extent as quite to have disappeared, and left only isolated points behind. Examples on a large scale are the Aiguille Verte, the Aiguille du Moine, the strangely shattered Aiguilles de Charmoz, the Aiguilles Rouges, all the mountains on both sides of the Valley of Chamouny, the Schreckhörner, and Grindelwald Viescherhörner in the Bernese Alps, the whole southern wall of the Bergell in the Grisons, etc., etc.

"But a different kind of atmospheric action attracts our attention in the Alps, and that in the most singular manner, and in places where the explanation is not at once obvious. This appears in the so-called 'Devil's Mills' or 'Seas of Rock' on the highest points of many isolated mountains. The Sidelhorn, close to the Grimsel, is one of the most visited points of view in the Bernese Alps. It is easily reached from the Hospice in two or two and a half hours. The nearer one approaches to the summit, the more do the vast rock ruins accumulate, piled wondrously over each other, till at length the highest point is covered with a perfect chaos of such loosely massed granitic blocks of gneiss. At times a certain disturbed stratification may be observed, something like plates laid upon each other; then again, in other places, a tolerably regular step-like formation, but in general they lie without recognizable order. This phenomenon, which frequently occurs on summits, is the result of a weathering of the granite, but of that kind in which more or less the scaly structure was once predominant. The brothers Schlagintweit represent in their atlas* such disorganized scales of gneiss. As the fanciful Jean Paul employs the beautiful picture 'graves are the mountain-tops of a far new world,' here in reality the mountain tops are graves of a past world. The grandest and most imposing masses of granitic rock are only to be found in the central Alps. There they often tower in such fearful sublimity, like vertical walls of rock palaces above the deep valley-hollows, that one is startled at their greatness. He who has never seen the dusky pyramid of the Finster Aarhorn from the 'Abschwung' on the Aar Glacier, as it rises in naked sublimity from the snow-beds to the clouds; he who has not journeyed round the south-east of Mont Blanc, and seen its central mass from the Cramont or the giant rocky brows of the Grand Cornier, Dent Blanche, and Weisshorn, from the depths of the Einfischthal, will hardly

* To the 'Neue Untersuchungen über die Physicalische Geographie und Geologie der Alpen.'

be able to construct for his imagination a right measure of their colossal relations; and yet all these granite giants are far exceeded as to the impression which they make upon the eye by that steep abyss unto which the Monte Rosa sinks at the head of the valley of Macugnaga. It is the greatest vertical magnitude of the European continent. The limestone Alps, the Diablerets, Dolden and Gespaltenhorn, and Blumlis Alps, show mighty rock-fronts, but they shrink in presence of these granite walls to masses of the second order.

"We called granite the historic stone of the earth. It is so in the Alps in more than one respect. Its solemn rock-walls were often memorials of great deeds, which may be compared to the sublimest moments of classical antiquity. The undaunted Russian Suwaroff, a modern Epaminondas, who would rather have been buried in the clefts of the rocks than have given up his post, when his columns had repulsed the French under Gaudin in the narrow valley of Tremolu, left the heroic words 'Suwarow Victor' carved on the granite wall for an everlasting remembrance. Next day the cliffs of gneiss were witnesses of equally heroic deeds, where the Devil's Bridge spans the stormy waters of the Reuss with its bold arch. Over the granitic deserts of the St. Bernard, Bonaparte led his army to the victory of Marengo, in May, 1800; and when the Simplon Pass, the first great Alpine road, had been pierced by his orders, he had carved in the opening of the gallery of Gondo the words 'Aere Italo, MDCCCV., Nap. Imp.' Andreas Hofer, the host of Passeyr, was born in the granite country, and between granite rocks he fought his glorious fights for the freedom of the Tyrol. . . . Benedict Fontana breathed out his hero-soul upon the gneiss crystals of the Malser-haide. . . . And then the mighty December fight of 1478, in the Livinenthal, when a handful of herdsmen destroyed ten times their number of Milanese under Count Borelli, till the snows of Bellinzona were red with their blood. Then the hero-graves of the three thousand Confederates at Arbeno, who sank in a despairing fight before twenty-four thousand Lombards in 1422. The double blood-baptism of the Valaisans at Ulrichen and on the Grimsel in 1422, and many other proofs of manly courage and bold deeds—are they not remembrances which have carved their memorial in letters of flame for men's hearts on the rock-tablets of these granite colossi?

"But the dull stone tells us of still more, of times lying further back, of an epoch when the Alps stood as they stand to-day, but when the human race was not. These memorial stones are the 'erratic blocks.'"

The quotations we have given will show the eloquent turn of the author's mind; but from them it will be readily seen that while admitting that we like the boldness of his speculations, and admire the truthfulness of some of his remarks, we cannot always assure the soundness of his geological statements.

Erratic blocks, the Nagelfluh, landslips, ban-forests, the Wettertanne, prostrate firs, and Alpine roses, chestnut-woods, cloud pictures, waterfalls and mountain snow-storms, avalanches, glaciers and Alpine summits, mountain passes and Alpine roads, hospices, chalet-life, the goat-boy, the wieldheuer, the Alpine feast, timber-fellers and floaters, mountaineers and village-life in the Alps, all form topics equally delightful, treated in language as fanciful or as wild as the subjects themselves, and containing a great amount of facts and observations, to be read with interest by geologists. To the general reader this must prove a charming book; but dealing as we do with a speciality, we can nevertheless recommend it to the votaries of our science as an admirable description of Alpine scenery and conditions, from the perusal of which they will rise with new thoughts and ideas for deep reflection.

Monographie des Gastéropodes et des Céphalopodes de la Craie supérieure du Limbourg. By M. J. Binkhorst.

Twelve years ago M. Binkhorst took up the study of the superposition of the cretaceous beds of Limbourg, and of the special fauna which each contained. His first essay, 'Esquisse Géologique et Paléontologique des Couches crétacées du Limbourg et plus spécialement de la Craie tuffeau,' was published in 1859, and the subject was further completed by a communication to the Geological Society of France, in the November of that year. In his first researches he felt surprise, as many of us collectors have done in England, at the few species of Gasteropods compared with the representatives of other classes of marine animals. But he soon began to account for this seeming paucity. He knew that the few species cited were found in the friable beds worked in the quarries, and that others were found in the state of casts and moulds in the hard strata which traverse the Upper Chalk in the environs of Maestricht and Heerlen. Occupying himself then with assiduous researches for many years in these beds, he offers now in this Monograph of the Gasteropods of the Upper Chalk, no less than a hundred and six species belonging to thirty-eight genera. The species described in this excellent memoir, which is illustrated by six large and beautiful plates, containing 270 figures, are :—*Rostellaria papilionacea*, var., Goldf. ; *Rostellaria nuda*, n. s. ; *Triton Koninckii*, n. s. ; *Cancellaria obtusa*, n. s. ; *Pyrula ambigua*, n. s. ; *P. filamentosa*, n. s. ; *P. tuberculosa*, n. s. ; *P. planissima*, n. s. ; *P. fusiformis*, n. s. ; *Fusus Noeggerathi*, n. s. ; *Fusus glaberrimus*, Müll. ; *Buccinum supracretaceum*, n. s. ; *Voluta deperdita*, Goldf. ; *Voluta corrugata*, n. s. ; *V. Debeyii*, n. s. ; *Imbricaria Limburgensis*, n. s. ; *Cypræa Deshayesii*, n. s. ; *Natica patens*, n. s. ; *N. ampla*, n. s. ; *N. Royana*, D'Orb. ; *N. fasciata*, Goldf. ; *N. cretacea*, Goldf. ; *N. spissilabrum*, n. s. ; *Chemnitzia clathrata*, n. s. ; *Cerithium tuberculatum*, n. s. ; *C. tectiforme*, n. s. ; *C. alternatum*, n. s. ; *C. pliciferum*, n. s. ; *C. maximum*, n. s. ; *Nerinæa ultima*, n. s. ; *Aporrhais Limburgensis*, n. s. ; *Turritella quinquecincta*, Goldf. ; *T. plana*, n. s. ; *T. Omaliusi*, Müll. ; *T.? sinistra*, n. s. ; *T. nitidula*, n. s. ; *T. conferta*, n. s. ; *T. Falcoburgensis*, n. s. ; *Vermetus clathratus*, n. s. ; *Scalaria Haidingerii*, n. s. ; *Solarium cordatum*, n. s. ; *Xenophora onusta*, n. s. ; *Nerita Montis Sancti Petri*, n. s. ; *N. rugosa*, Hœninghaus ; *N. parvula*, n. s. ; *Turbo detritus*, n. s. : *T. bidentatus*, n. s. ; *T. Strombeckii*, n. s. ; *T. rimosus*, n. s. ; *T. granose-cinctus*, n. s. ; *T. clathratus*, n. s. ; *T. rudis*, n. s. ; *T. filogranus*, n. s. ; *T. cariniferus*, n. s. ; *Trochus Goldfussii*, n. s. ; *T. Montis Sancti Petri*, n. s. ; *T. lineatus*, n. s. ; *T. sculptus*, n. s. ; *Infundibulum Ciplyanum*, De Ryckholt ; *Delphinula spinulosa*, n. s. ; *Emarginula fissuroides*, Bosquet ; *E. Muelleriana*, Bosq. ; *E. supracretacea*, De Ryck. ; *E. conica*, n. s. ; *E. Dewalcquii*, n. s. ; *E. radiata*, n. s. ; *E. Hœvenii*, n. s. ; *E. depressa*, n. s. ; *E. clypeata*, n. s. ; *Hipponyx (Capulus) Dunkerianus*, Bosq. ; *Patella parmaphuroidea*, n. s. ; *Acmæa lævigata*, n. s. ; *Siphonaria antiqua*, n. s. ; *Dentalium Nystii*, n. s. ; *Actæon granulato-lineatum*, n. s. ; *Avellana gibba*, n. s. ; *Avellana ventricosa*, n. s. ; *Turbinella supracretacea*, n. s. ; *T. plicata*, n. s. ; *Cancellaria ? reticulata*, n. s. ; *Pyrula nodifera*, n. s. ; *P. parvula*, n. s. ; *P. ? plicata*, n. s. ; *Fusus lemniscatus*, n. s. ; *F. squamosus*, n. s. ; *F. formosus*, n. s. ; *F. oblique-plicatus*, n s. ; *Oliva ? prisca*, n. s. : *Mitra Waelii*, n. s. ; *M. cancellata*, Sowerby ; *Voluta monodonta*, n. s. ; *Volvaria cretacea*, n. s. ; *Natica prælonga*, n. s. ; *N. Bronnii*, n. s. ; *Cerithium novem-striatum*, n. s. ; *Turritella Ciplyana*, n. s. ; *Solarium Kunrædtense*, n. s. ; *Turbo intexus*, n. s. ; *T. scalariformis*, n. s. ; *T. Herklotsii*, n. s. ; *T. granuloso-clathratus*, n. s. ; *T.*

Zekellii, n. s.; *Haleotis ? antiqua*, n. s.; *Emarginula Kappi*, n. s.; *Acteon cinctus*, n. s.; *Acteonella*, sp.

All these, it will be seem, are new, except about a dozen described or quoted by Goldfuss, Hœninghaus, Bosquet, and De Ryckholt.

This fauna M. Binkhorst considers as belonging to the zone between high and low water in a littoral region of a subtropical ocean. Many of the genera which compose it are common to hot and to temperate seas, such as the *Buccinum*, *Turbo*, *Emarginula*, *Scalaria*, etc.; but others, such as the *Voluta*, *Pyrula*, *Cancellaria*, *Solarium*, *Vermetus*, *Turbinella*, etc., only inhabit the hot seas. The facies of the fauna indicates also, he thinks, the proximity of reefs of corals, great quantities of the debris of anthozoarians so fill many of the beds as almost to form them. It is probably to the high temperature of this epoch, he considers, that we owe the great species *Voluta deperdita*, *Cerithium maximum*, and those brilliant colours which many of the bivalves that he has found, have even in their ancient burial-place.

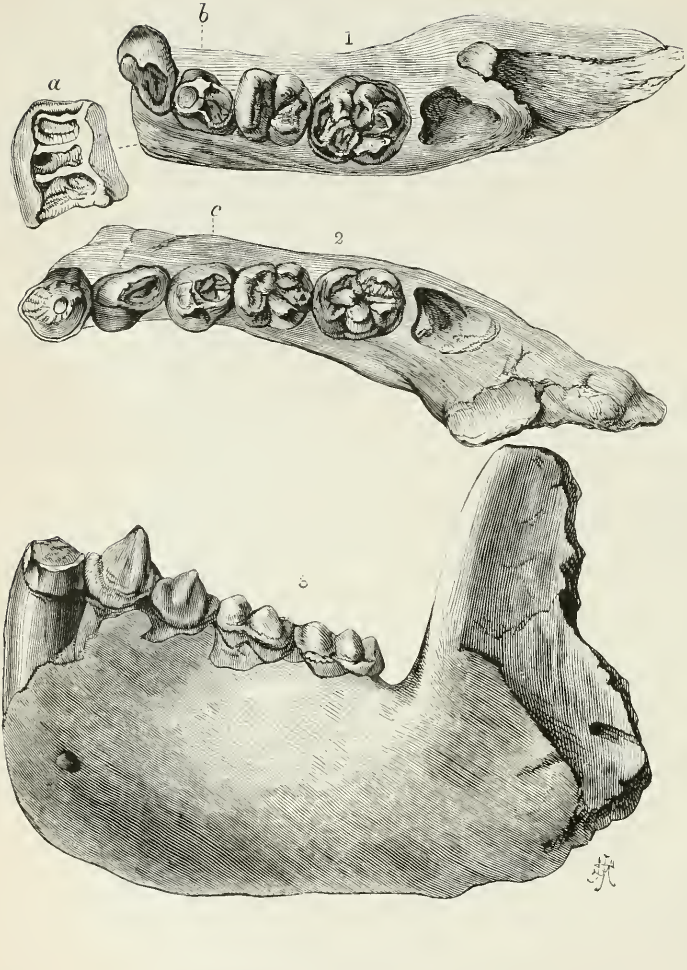
"Judging," he adds, "from the great number of fragment of casts and moulds belonging to species of which the determination and the description await the discovery of more perfect examples, those that we have described represent only a small portion of the mollusks of this class which were the contemporaries of the *Mosasaurus*."

He has also described a cephalopod, characteristic of the "marnes sans silex de Vaels," a score of species of cephalopods from the Upper Chalk, some of which are new, and among others many of the genus *Ammonites*, probably the last representatives of that important and numerous family, and one species of the *Acanthoteuthis*, D'Orb., which with the *Acanthoteuthis prisca* of Solenhofen are the only fossil species known to M. Binkhorst as described up to this time, and this the only one of the cretaceous rocks. In England however an Acanthoteuthis (*A. antiquus*) is recorded from the Oxfordian beds of Christian Malford and from Trowbridge in Wiltshire.

It is not a little singular however to find these remains of Gasteropoda occurring in the hard beds of the Limbourg district, in the form of casts and moulds, exactly as the remains of Gasteropoda do in those hard beds of the English white chalk to which Mr. Whitaker has lately given the name of Chalk-rock.

The great number of new species figured by M. Binkhorst should be an encouragement to the many British collectors of cretaceous fossils, to search well these hard beds for the Gasteropoda, of which in the form of casts they do, as we know personally by experience, contain great quantities.

In the beds of this hard chalk at Dover or Maidstone, a cubic foot of rock cannot be broken up without some casts of what appears to be an exquisitely sculptured Trochus being found. Dentalia also are common, and small (young?) Ammonites. We hope soon therefore to see M. Binckhorst's species matched by English examples, and some new forms added to them from our own famous chalk localities.



DRYOPITHECUS FONTANI.

[From M. Lartet's Original Figures.]

Figs. 1 and 2. Jaw in three pieces (top view). 3. Side view of Jaw.

THE GEOLOGIST.

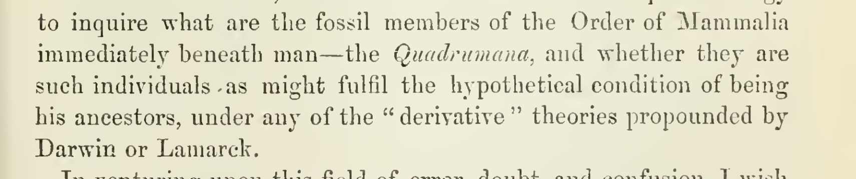
MARCH 1862.

FOSSIL MONKEYS.

BY CHARLES CARTER BLAKE, ESQ.

In these days of progress, when the alleged origin of the human race from a transmuted gorilla is canvassed as a demonstrable and demonstrated theory by many geologists and zoologists, and the pens of various distinguished writers are occupied to prove the absolute identity of man's physiological and psychological nature with that of the beasts of the field, it behoves the candid student of palæontology to inquire what are the fossil members of the Order of Mammalia immediately beneath man—the *Quadrumana,* and whether they are such individuals as might fulfil the hypothetical condition of being his ancestors, under any of the "derivative" theories propounded by Darwin or Lamarck.

In venturing upon this field of error, doubt, and confusion, I wish dispassionately to endeavour to divest myself of any adherence to any



Humerus of *Dryopithecus Fontani.* (Scale ½ linear.)

prevailing doctrine. Imbued strongly with the conviction of the unity of type of all animals, and with the probability of their common origin by secondary law, yet I advocate no theory which derives mankind from any known recent or fossil species of animal. Convinced of the distinctive peculiarities of the human brain, characters not satisfactorily demonstrated in any animal, yet I do not shut my eyes to the analogy which sometimes exists between the structures in the lowest men and the highest apes. Affirming both man's psychological supremacy, as "a little lower than the angels," and his physiological adaptation as the highest of animals, contradicting neither the cherished and captivating precepts of Teleology, nor the bold and comprehensive generalizations of Morphology, the palæontologist who loves truth alone for truth's sake has most need to join in the prayer of Bunsen,

"Father! as upward I gaze, strengthen my eye and my heart."

Geological science, steadily progressing since the time of Cuvier, in whose time no species of fossil monkey was known, now discloses to us no fewer than thirteen species of *Quadrumana*, as by the annexed table:—

	Eocene.	Miocene.	Pliocene.	Locality.
Catarrhini (Old World Monkeys)				
Dryopithecus Fontani	—	*	—	France : Gers.
Pliopithecus antiquus	—	*	—	France : Gers.
Mesopithecus Pentelicus	—	*	—	Greece : Pikermi.
Mesopithecus major	—	*	—	Greece : Pikermi.
Semnopithecus magnus	—	—	*	India : Sewalik.
Semnopithecus sp................	—	—	*	India.
Semnopithecus monspessulanus	—	—	*	France : Montpellier.
Macacus pliocenus...............	—	—	*	Engl.: Grays, Essex.
Eopithecus Colchesteri	*	—	—	Engl.: Kyson, Suffolk.
Platyrrhini (New World Monkeys)				
Protopithecus Brasiliensis......	—	—	*	Brazil.
Cebus macrognathus............	—	—	*	Brazil.
Callithrix primævus	—	—	*	Brazil.
Jacchus grandis........	—	—	*	Brazil.

It is worthy of remark that no fossil species of Strepsirhine Quadrumana, or Lemurs, has hitherto been discovered; but when we reflect on the restricted locality of the modern *Lemuridæ* to Madagascar and to a few of the islands of the Indian Archipelago, countries where the geologist's hammer has not yet rung, we may reasonably expect that the industry of such enterprising travellers as Dr. Sandwith may procure for us evidence of fossil Lemurs. The *à priori* analogy in favour of their existence in the tertiary strata rests upon the fact that they are zoologically inferior to the true monkeys, and consequently more likely to have existed previously to them.

The fossil monkeys of the New World are all of one geological age, the later pliocene. They are, moreover, analogous to the existing Platyrrhine monkeys of Brazil, thus proving that the physiological division of true monkeys into Catarrhine and Platyrrhine existed so long ago as the Pliocene age. We find no Platyrrhine monkeys in the Old; no Catarrhine in the New World. The *Protopitheeus Brasiliensis* discovered by Dr. Lund in limestone caverns in Brazil, offers the nearest analogy to the howler monkeys (*Mycetes*) which are still found in the same locality. The Sapajou (*Cebus macrognathus*), the Sagouin (*Callithrix primævus*), and the little Ouistiti (*Jacchus grandis*), are all Brazilian forms. No Transmutationist will assert the probable, or even possible, derivation of American types of men from the Platyrrhine monkeys.

Turning to the Old World, the earliest and one of the most interesting forms of fossil monkey has been discovered in the Eocene sand, at Kyson in Suffolk. It is the *Eopithecus Colchesteri* of Owen. Its nearest living analogue, the *Macacus rhesus*, is found on the banks of the Ganges. The Macacine form of monkey reappears in the pliocene beds at Grays, Essex, again reproducing a Bengal form, the Bonnet Chinois monkey (*Macacus Sinicus*). The older pliocene or newer miocene beds of the Sewalik, or Sub-Himalayan range, produce two species of *Semnopitheeus* not generally distinct from those of the present day. A third *Semnopitheeus* is found in the pliocene sands at Montpellier. In the miocene beds of Pikermi, at the foot of Pentelicon, in Greece, are to be found the remains of two species of *Mesopithecus*, a genus which Professor Wagner considers as intermediate between *Hylobates* and *Semnopithecus*; but Professor Owen has pointed out that the third lobe of the last molar is as well developed in *Mesopitheeus* as in *Semnopithecus*.

Hitherto we have only had to deal with tailed monkeys, mostly of small dimensions, and not differing much in type from those of the present day. Evidence has however been afforded to us of the occurrence of two forms of fossil Gibbons (*Pliopithecus* and *Dryopithecus*), one of which has been regarded by more than one distinguished naturalist as approaching nearer to the human type than even the Gorilla. The illustrious Sir Charles Lyell has stated "that in anatomical structure, as well as in stature, the *Dryopithecus* came nearer to man than any quadrumanous species, living or fossil, before known to zoologists." Professor Owen's examination however of the plates figured in M. Lartet's memoir* has led him to a very different conclusion.

Stress has been laid upon the inferior size of the canine in *Dryopithecus*, compared with the Chimpanzees, Gorillas, and Orangs, as indicating its affinity to man; but the inferior monkeys also often exhibit this character, and "it is by no means to be trusted as significant of true affinity, even supposing the sex of the fossil to be known as being male."†

The characters in which *Dryopithecus* approaches to the lower form *Hylobates* are,—the cylindric form of the humerus; the verticality of the forepart of the jaw; the shape of the forepart of the coronoid process, slightly convex forwards, causing the angle which it forms with the alveolar border to be less open than in Man, the Gorilla, and Chimpanzee, and the mode in which the molar teeth are developed. Professor Owen sums up by stating,—"There is no law of correlation, by which, from the portion of jaw with teeth of the *Dryopithecus*, can be deduced the shape of the nasal bones and orbits, the position and plane of the occipital foramen, the presence of mastoid and vaginal processes, or any other cranial characters determinative of affinity to Man; much less any ground for inferring the proportions of the upper to the lower limbs, of the humerus to the ulna, of the pollux to the manus, or the shape and development of the iliac bones. All those characters which do determine the closer resemblance and *affinity* of the genus *Troglodytes* to Man, and of the genus *Hylobates* to the tailed monkeys, are at present unknown in respect of the *Dryopithecus*."

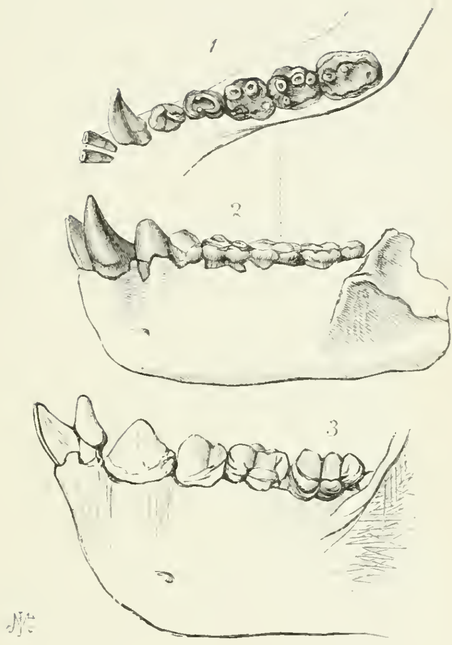
As regards *Pliopithecus*, no doubts can exist as to its affinity with *Hylobates*.

We have thus amongst the fossil species of *Simiadæ* no form sufficiently allied to Man to have served as his ancestor; no form which approaches so near to him as the Gorilla or Chimpanzee.

The theory which would identify man as the descendant of any of these existing species has been often and satisfactorily disproved.

The analogy of the genesis of the whole human race to the genesis of each particular individual is obvious. Knowledge is denied to each of us how we came, from what we came, whence we came, whither we go. The feeble and obscure light of analogy seems to indicate an origin analogous to that of all animals—the cell. Through

* Comptes Rendus Acad. Sciences, Paris, vol. xliii.
† Owen on Gorilla, Proc. Zool. Soc. 1859.



PLIOPITHECUS ANTIQUUS.

[From M. Lartet's Original Figures.]

Fig. 1. Top view of Jaw. 2. Side view (*nat. size*). 3. Side view of Jaw of recent Gorilla. (Scale ½ linear.)

what ancestry man may have been derived from such primordial form he knows not. Suffice it to say that it is neither to Gorilla, to Kooloo Kamba, to Orang, to *Dryopithecus*, nor to any known recent or fossil ape he can claim his descent.

But the mind of the palæontologist, still aiming at a solution, recalls the hideous ape-like character of the Neanderthal man, and strives to divest himself of the idea that this frightful being belonged to the same race as himself. Demonstration is lacking of the mode by which even so low and degraded a type could have been derived from the apes. Whether demonstration will ever afford us such a solution is the object towards which Anthropologists, Zoologists, and Geologists are directing their best endeavours,—with what success remains to be seen.

GEOGRAPHICAL DESCRIPTION OF FOSSIL MONKEYS.

Strata.	Europe.	Asia.	America.	Africa.	Australia.
Pleistocene:— Historical .	Man	Man and Orangs.	Man	Man and Chimpanzees.	Man
Prehistorical.	Man		Man?	No fossil monkeys yet discovered.	No recent or fossil monkeys.
Pliocene . .	Macacus Semnopithecus		Protopithecus Cebus Callithrix Jacchus		
Miocene . .	Dryopithecus Pliopithecus Mezopithecus	Semnopithecus			
Eocene . . .	Eopithecus				

When we view the skeleton of man, when we trace the points of difference between his form and that of the anthropoid apes, we are struck with the "all-pervading" unity of plan and "similitude of structure,—every tooth, every bone strictly homologous,"—which is presented by these organs throughout their diversified adaptations. We can trace out in both the human jaw and that of the ape the same canine tooth: *e. g.* as the modified representative and homologue of the canine in *Hyænodon*, now subserving its duty in the gorilla as an almost carnassial laniary, now dwarfed in man into the semblance merely of a more conical incisor. In each bone of the metacarpals and metatarsals of *Homo* is seen a repetition of the same structure in *Troglodytes*. Few but those who have studied the subject with the anxiety of the practised observer, can appreciate the pleasure with which the morphological student detects in the gorilla skull a structure, however trivial, which he has also found in man, even when he recognizes such an organ as the styloid process of the temporal in man in the angular termination of that "ridge which extends from the ectopterygoid along the inner border of the *foramen ovale* in the Gorilla," such "styloid" being absent in the Chimpanzees, Orangs, and Gibbons, and probably in the fossil *Dryopithecus*. In every structure that shows on the part of the lower forms of man an approach, either in degree or in kind, with a similar structure in the higher Quadrumana, the disciple of unity of descent finds a basis for his arguments; whilst he who abides, and may be working out, a demonstration of the mode of origin of species, accepting the evidence of their origin by law, and the maintainer of the faith in special creation, gives due weight to, and watches for the distinctions which limit the sub-class Archencephala.

GEOLOGY OF CASTLETON, DERBYSHIRE.

By John Taylor, F.G.S.

Now that the "season" is fast approaching for field-work, a few remarks concerning the geology of the above locality will doubtless be acceptable to many of our readers. Such of them who may have broken ground on it will remember with pleasure its beautiful scenery and the peculiar charms which attract the naturalist to it. That it is interesting in more respects than a merely geological one, is shown by the botanists who wander there in search of rare and beautiful plants, and the antiquarian who finds in its old keep and other more ancient relics subjects for thought. Above all "Moultrassie Hall" and "Peveril Castle" hold an honoured place in our literature enshrined by the genius of Scott. The flora of the locality is particularly interesting, especially that of the lower class. Maidenhair, spleenwort, and rue-leaved spleenwort grow upon almost every wall; and the cystopteris in several species is also common, whilst the adder's-tongue and the little moonwort are exceedingly plentiful

Fig. 1.—The "Peak" Cavern.

in the richer pastures. The number of mosses is exceedingly great. The beautiful *Bryum dendroides* and others abound in the moister spots of the Cave Dale. In fact, the botanical character of the vegetation hereabout is so peculiar to the three formations which are found as to form a geological map to the underlying rocks, coloured by nature herself! The limestone clothed with its short and beautiful carpet of green; the black shales of the Yoredale rocks covered by their stunted and brown vegetation; and the millstone-grit in the glowing summer-time quite purple with the flowers of the heather. And for land shells no other locality can compete with it. From the robust *Helix aspersa* to the diminutive *Pupa* numerous species intervene; some of them, such as *Clausilia* and *Pupa*, being more numerous in individuals than any other place that I have visited.

But to the geologist the rocks present treasures of fossils most beautifully preserved. I have found the *Terebratula hastata* retaining its purple colour-bands as beautifully as when alive in the carboniferous seas; and in some places every slab that is turned up is matted with Retepora and Fenestrella. Coming here from Manchester, along the new road from Chapel-en-le-Frith, the first place where we meet with the limestone is about a mile and a half distant from the town. This hill, Trecliff, is about six hundred feet in height, and the dip of the beds is about 25° in a direction N.N.E. It is in this hill that the "Blue John" mines are situated; and is the only locality in the country where this peculiar mineral is met with. It lies in "pipe-veins," having the same inclination as the rocks which the veins traverse. One of these veins lies in a sort of clayey stratum, and another seems to be imbedded in the nodule state in a mass of indurated *débris*. Besides these, the whole of the limestone masses are fractured and cracked, and, in addition to the pipes, the sides of the cavities are lined with the most perfect and beautiful sky-blue cubes of fluor, and the rhombic crystals of calcite. I remember scarcely anything with greater pleasure then an adventure in search of minerals a year or two ago, in one of these caverns, which was richly rewarded. Witherite, fluor-spar, varying in colour from transparency to rose, blue, violet and other colours, selenite, and occasionally phosphate of lead, are all found in the lead-mines of the neighbourhood. Some varieties of calcspar have the property of double refraction, like Iceland spar.

Nearly all the characteristic fossils of the carboniferous limestone abound, as may be seen by glancing at the names of the localities given in Professor Phillips's 'Geology of Yorkshire.' The richest localities for obtaining them is just below the "Blue John cavern," and in the gorge at the back of the town, which goes by the name of the Cave Dale. In geologizing along the side of Trecliff hill, one cannot but be struck with the various groups of fossils which the different beds present. The *lower* beds contain great quantities of *Phillipsia*—heads, carapaces, etc., being very frequently met with, and occasionally they are found whole. Just as we should have expected from knowing that the family of Trilobites died out with the mountain limestone, as we continue our researches higher up in the beds we find their remains becoming more scanty, until at the top they are exceedingly rare. One bed is rich in zoophytes, another in goniatites, whilst another is composed of the broken fragments of *Sanguinolaria*, and the whole of the beds contain numbers of *Spirifer imbricatus*, which connects them like a huge bracket from top to bottom. Some rare geologizing may be had along the lower beds; almost every stroke of the hammer lays open something novel.

The remarkable fissures which occur in the limestone of Derbyshire have afforded matter of speculation to the curious for centuries; the most remarkable one is called the Winnats, and is about a mile distant from Castleton. It gives rise to the most sublime scenery, for the fissure is caused by the splitting of a hill in twain, and the steep precipices on either hand for the distance of a mile and a half, resemble the ruins of old towers and buttresses, in some places clad with ivy, and tenanted by bats and owls. Another such fissure is at the back of the town, and has been already referred to. In some places the passage at the bottom of this is not above three yards in width, and is much of a character, in other respects, with the Winnats. Much speculation has arisen as to the origin of these rents; they occur at nearly right angles to the line of strike, and have doubtless been formed in the first instance by the upheaval and desiccation of the rocks, thus:—

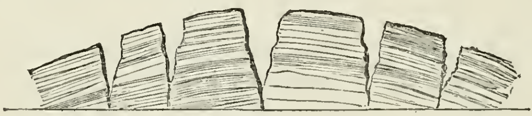


Fig. 2.

Subsequent to this they have been worn and channelled by atmospheric and aqueous action. They have been attributed to plutonic agency, but it needs little geological knowledge to see that the above theory is the true one. Along the lower beds in the Cave Dale there is another good spot or two for the geologist. Here are found numbers of trilobites, some quite entire; groups of the entomostracan *Cytheræ*, and that rare fossil the *Cyclas radialis*. One bed seems quite a nest of *Pleurorhyncus armatus*, although they are very fragile and require great care to extract them with the cone entire. Plutonic action has not been absent in the neighbourhood, for at the top of this fissure are beds of greenstone, and an imperfectly columnar basalt, whilst the limestone around seems to be somewhat crystallized by the heat to which it has been subjected by the intrusion.

Old Mam Tor, the "Shivering Mountain," in geological position lies just above the limestone. The shales which compose it are speedily decomposed by atmospheric agency, and hence have given rise to the popular name which the mountain bears. The inclination of its beds is E.N.E., and the intensity of their dip about 40°. These beds can be traced through Hope on to Hathersege; and along the brook side, below Mam Tor, a good section is displayed, where they are seen abutting against the lower limestones. Along the stream at Hope good sections are also exposed, and they are seen in several places on the road to Bradwell. The bottom beds of the shales are intercalated with stony bands composed of the remnants of encrinite-stems and fragments of shells, and have been caused by the denudation of the limestone during their formation. The bottom shales are rich in *Aviculo-pectens*, *Goniatites*, *Posidonia*, etc., and the numerous iron-stone bands higher up the hill are rich in small goniatites, which are frequently found pyritized.

The most striking peculiarity of these shales is the fact that about a couple of miles from Castleton, where they rest upon the limestone, the bitumen which has steeped them has also percolated and oozed out into the limestone, turning it quite black, as also the fossils which, when split open, are often seen to contain a little globule of bitumen. Here we see the decomposed remains of two subdivisions separated by a great gulf of time, mingling together, both testifying to the great law of death which has prevailed since the dawn of life. When the fossils of the limestone are cleft open, they are often seen to contain a little globule of bitumen. Do not all the labours of the geologist prove that death is as much a natural law as that of birth, and that creation has been concomitant with extinction, as with individuals has been life and death?

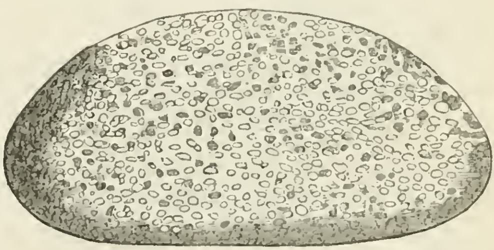
NOTES ON A NEW MASS OF METEORIC IRON FROM THE CORDILLERA OF COPIAPO, CHILE.

By Wm. Bollaert, F.R.G.S.,

Cor. Mem. Univ. Chile and Amer. Ethnological Society, etc.

This was found by a muleteer, in June, 1858, when passing the Cordillera from Catamarca to Copiapo, and brought by him to the latter city. He took it to be a *rodado*, or piece of silver-ore that had been broken from a vein and rounded by being washed with stones, say in the bed of a river; but on its being examined by Dr. David Garcia (a pupil of Domeyko), at Copiapo, he pronounced it to be a mass of meteoric iron.

Dr. D. Garcia is the manager of the "Transito" maquina or silver amalgamating works, and has this specimen in his possession. Mr. Abbott tells me it is considered a most interesting specimen, being so perfect (not a broken fragment), and whole.



Meteorite from Copiapo.

The mass is covered thickly with a series of shallow pits or depressions, about $\frac{1}{8}$ to $\frac{1}{10}$ of an inch deep. The spaces between the holes are bright like steel. Its weight is about 12 or 13 lbs.

In consequence of finding a difficulty in fixing the position or positions of the Atacama Meteorite in 1826, I gave Peine, Guanaquero, Chala, and two other spots north of Challa, all in the desert of Atacama; also Miño, to the east of Mani, near the Peruvian and Bolivian boundaries. I tried to get across the desert in 1828, from the coast of the Pacific, in the hope of examining the localities of Guanaquero and Peine, near to one or other of which places I hoped to find the meteoric deposit. I was lost for awhile in the desert of Atacama, and had to return to the coast. Near to Toconao, north-east of Peine, was supposed by Sir W. Parish to be the spot; but in 1853, Dr. Philippi determined Imilac, a few miles south-west of Peine, to be the spot, or one of the spots of the fall of the Atacama Meteorite.

A very large specimen from Atacama is in the possession of Domeyko, in Santiago, in Chile; some others I have seen, as well as many small fragments which fell at Imilac; as to my small specimen obtained in 1826, when I was in Tarapuca, it may or may not have been collected at Imilac.*

The large specimen of the Atacama Meteorite deposited by me in the British Museum, I procured on the west coast in 1854. I have had some doubts as to whether Imilac ought to be given as the locality of its fall. I made this observation in my paper to the Meteorological Society, 1858, as to this specimen; the same will apply to a slice of meteoric stone in the same Museum, and that in the Museum of Practical Geology. The information I had was what I let the British Museum have, that it (and others, one weighing over 50lbs.) were brought to Cobija by a muleteer, from "somewhere to the east in the desert of Atacama, and it was thought there were several similar deposits in the track to Antofogasta."

These specimens have the external mechanical character of the Imilac specimens, but the metallic part is dark, as if much oxidized, and the earthy part is more crystalline.

Nicol, in his 'Mineralogy,' gives an analysis by Rivero of meteoric iron from "Potosi:"—iron, 90·24; nickel, 9 76 = 100·0. Domeyko gives for the Atacama one (Imilac):—iron, 88·54; nickel, 8·24; cobalt, 1·14; silica, 0·16. From this difference of composition compared with that of the one from "Potosi," we may say that Imilac was not its place of deposit.

I advert in my paper to the Meteorological Society to three stones found four leagues inland from Playabrava (23° 35′), two round and porous, the other porous, flat, and triangular. I suspect them to be meteoric (for they are said to be of "iron"), and the locality they were found in, although near the latitude of Imilac, is much further to the west. Having disposed of these amygdalo-peridotic varieties,

* I gave 23° 30′ S., 68° 50′ W. as the position of Dr. Reid's specimens (which are at Ratisbon), and there may be a doubt that they came from Imilac, which is in 23° 49′ S., 69° 14′ W.

that of Imilac, which may have fallen about 1820, I will now refer to Shepard's account in 1850 of three new North American meteorites, with observations upon the general distribution of such bodies, and on the falling of meteorites over a limited zone or area of the earth's surface. He says:—"Out of the fourteen depositions of meteoric matter on the American continent within the last few years, thirteen have taken place between 33° and 44° N.: one only at Maceio, in Brazil, south of the Equator,—a distribution exceedingly unequal." He however concludes "that there is a zone or region over which meteoric falls are more frequent than elsewhere."

Run the eye easterly from the meteoric region of Atacama, on the west coast of South America, for ten degrees of longitude, and now we come upon that extraordinary deposit of solid meteoric iron of Otumpa* (about thirteen tons), of which there is so magnificent a specimen in the British Museum. Near Bahia, in Brazil, is another mass of iron of 14,000 lbs.

On Arrowsmith's old map of South America, at a distance of twenty-three geographical miles S.S.W. of the city of Tucuman, appears the word "Meteores;" does this mean that meteoric iron has been found there? Antofogasta is about 2° W.N.W. of the "Meteores," and I have reason to believe that meteoric iron exists about there.

In the map to Wilcocke's 'Buenos Ayres,' at the junction of the Bermejo and Paraguay rivers are the "Montes de Hierro;" *monte* may mean mountain or forest. This locality is about 2° N.E. of Otumpa, and the iron spoken of here may be meteoric.

In the 'Coleccion de Memorias Cientificas, etc., por M. E. de Rivero y Ustariz' (Brussels, 1857), there are details and analyses of several masses of meteoric iron found in the Cordillera of the Andes (of Bogotá).

My impression is, that when this subject of meteoric zones is worked out, more falls will have to be recorded in South America than given by Shepard.

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

Geological Society of London.—*January* 22, 1862.—Sir R. I. Murchison, V.P.G.S., in the chair. The following communications were read:—

1. "On some Flint Arrow-heads (?) from near Baggy Point, North Devon." By N. Whitley, Esq., communicated by J. S. Enys, Esq., F.G.S. Immediately beneath the surface-soil above the "raised beaches" of North Devon and Cornwall, the author has observed broken flints; and even

* It is not known when the Otumpa iron fell. It was visited by Celis and Cerviño in 1783. The length of it is $3\frac{1}{4}$ yards, 2 yards in width, 4 feet 6 inches deep, and contains $9\frac{3}{4}$ cubic yards. This appears to be independent of smaller pieces. It is called by the natives the Masa de fierro, or mass of iron; the meteorite of the Chaco; of the Chaco Gualamba. It was discovered by people from Santiago del Estero on one of their expeditions to "malear," or hunt for honey and wax. It is in about 27° 43′ S., 2° 40′ W. of Buenos Ayres.

at the Scilly Isles such flints are found. At Croyde Bay, about half-way between Middle-Borough and Baggy Point, at the mouth of a small transverse valley, Mr. Whitley found them in considerable number, collecting about 200 specimens, of which about 10 per cent. of the splintered flints at this place have more or less of an arrow-head form; but they pass by gradations from what appear to be perfect arrow-heads of human manufacture to such rough splinters as are evidently the result of natural causes. Hence the author suggested that great caution should be used in judging what flints have been naturally, and what have been artificially shaped.

2. "On some further Discoveries of Flint Implements in the Gravel near Bedford." By James Wyatt, Esq., F.G.S. Since Mr. Prestwich described the occurrence of flint implements near Bedford ('Geological Society's Journal,' No. 67, p. 366), Mr. Wyatt and others have added seven or eight to the list, from the gravel-pits at Cardington, Harrowden, Biddenham, and Kempston. Mr. J. G. Jeffreys, F.G.S., having examined Mr. Wyatt's further collections of shells from the gravel-pits at Biddenham and Harrowden, has determined seventeen other species besides those noticed by Mr. Prestwich, and among these is *Hydrobia marginata* (from the Biddenham pit), which has not been found alive in this country. At Kempston, Mr. Wyatt has examined the sand beneath the gravel (which is destitute of shells), and at 3 feet in the sand (19 feet from the surface) he found *Helix, Succinea, Bithnia, Pupa, Planorbis*, etc., with flint flakes.

3. "On a Hyæna-den at Wookey-Hole, near Wells, Somerset." By W. Boyd Dawkins, Esq., F.G.S. In a ravine at the village of Wookey-Hole, on the southern flanks of the Mendips, and two miles N.W. of Wells, the river Axe flows out of the Wookey-Hole Cave by a canal cut in the rock. In cutting this passage, ten years ago, a cave, filled with ossiferous loam, was exposed, and about 12 feet of its entrance cut away. In 1859 the author and Mr. Williamson began to explore it by digging away the red earth with which the cave was filled, and continued their operations in 1860 and 1861. They penetrated 34 feet into the cave, and here it bifurcates into two branches, one vertical (which was examined as far as practical), and one to the right (left for further research). A lateral branch on the left, not far from the entrance, was also examined. The cave is hollowed out of the Dolomitic Conglomerate, from which have been derived the angular and water-worn stones scattered in the ossiferous cave-earth. Its greatest height is 9 feet, and the width 36 feet; it is contracted in the middle, and narrow towards the bifurcation. Remains of *Hyæna spelæa* (abundant), *Canis Vulpes, C. Lupus, Ursus spelæus, Equus* (abundant), *Rhinoceros tichorhinus, Rh. leptorhinus* (?), *Bos primigenius, Megaceros Hibernicus, C. Bucklandi, C. Guettardi, C. Tarandus* (?), *C. Dama* (?), and *Elephas primigenius* were met with; remains of *Felis spelæa* were found when the cave was first discovered. The following evidences of man were found by Messrs. Dawkins and Williamson in the red earth of the cave—chipped flints, flint-splinters, a spear-head of flint, chipped and shaped pieces of chert, and two bone arrow-heads; and the author argues that the conditions of the cave and its infilling prove that man was contemporaneous here with the extinct animals in the pre-glacial period (of Phillips), and that the cave was filled with its present contents slowly by the ordinary operations of nature, not by any violent cataclysm.

February 5, 1862.—The following communications were read:—

1. "On some Volcanic Phenomena lately observed at Torre del Greco and Resina." By Signor Luigi Palmieri, Director of the Royal Observa-

tory on Vesuvius. In letters addressed to H.M.'s Consul at Naples, and dated December 17th, 1861, and January 3rd, 1862.

The author spoke of the evolution of great quantities of carbonic acid gas as seemingly coming from a great subterraneau reservoir, and as bubbling up in the sea and killing the fish. He also noticed the outbursts of springs of acidulous, and hot water; and especially mentioned the upheaval of the ground for some miles along the shore at Torre del Greco to the height of more than a mètre above the sea-level.

2. "On the Recent Eruption of Vesuvius." By M. Pierre de Tchihatcheff. M. Tchihatcheff's observations were made at Torre del Greco and Naples from December 8th to 25th. Near Torre del Greco several small craters (9–12) have been formed close to each other in an E.N.E.–W.S.W. line, at a distance of about 600 mètres E.S.E. of the crater of 1794; and either on a prolongation of the old fissure, or on one parallel. The phenomena mentioned by Signor Palmieri were described by M. Tchihatcheff in detail, who also alluded to the evolution of sulphuretted hydrogen, and suggested this as an explanation of the flames said to have emanated from the fissures in the ground at various places.

3. "On Isodiametric Lines as means of representing the Distribution of Sedimentary (clay and sandy Strata), as distinguished from Calcareous Strata, with especial reference to the Carboniferous Rocks of Britain." By E. Hull, F.G.S., of the Geological Survey of Great Britain.

The author exhibited maps of the Carboniferous rocks of England and Wales, and by means of coloured isodiametric lines showed the gradual thinning-out of the clays and sandstones in one direction, and that of the *limestones* in another. Upon these data he urged that the formation of limestone was distinct from the deposition of littoral, or clayey and sandy, deposits. The limestones were of organic origin, and formed in the clear deeps of the sea, which those essentially rock-forming creatures the foraminifera, corals, etc., inhabited, but not necessarily formed in deep seas. Thus the condition of the strata beneath us was that of a series of overlapping wedges. The feather-edges of the clays and sands being in one direction, and those of the limestones in the other—the former thinning out from the shore into the sea, the latter proceeding from the bottom of the sea and terminating towards the shore.

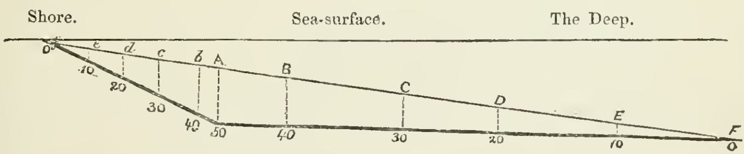


Fig. 1.—Primary Section of a Formation.

Thus where the limestones were thickest, as a general rule the sandstones and clays were thinnest; and *vice versâ*, when there was a great development of clays and sands the limestones were usually thin.

The author made a comparison of argillaceo-arenaceous with calcareous deposits, as to their distribution, both in modern and in ancient seas, and objected to calcareous strata being regarded as sediments, in the strict sense of the word. Noticing the distribution of sediments, in the Caribbean Sea, he referred to the relative distribution of limestones as compared with shales and sandstones in the Oolitic formations (comparing those of Yorkshire with those of Oxfordshire), in the Permian strata of England, and in the Lower Carboniferous strata of Belgium and Westphalia. After some observations on the nature of calcareous deposits, and on the contemporaneity of certain groups of deposits, dependent on the oscillatory movements of land and sea, the author described his plan of showing on maps the relative thicknesses of the two classes of strata under notice, by means of isodiametric or isometric lines (properly *isopithic*, or indicative of *equal thickness* of the strata).

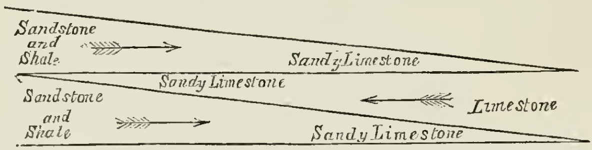


Fig. 2.—Distribution of the Calcareous and Sedimentary Strata of the Great Oolite, Oxfordshire.

Mr. Hull then proceeded to show the application of the isodiametric system of lines to the Carboniferous strata of the midland counties and north of England; showing that there is a *south-easterly* attenuation of the *argillo-arenaceous* strata, and a *north-westerly* attenuation of the *calcareous* strata. The existence, in the Carboniferous Period, of a barrier of land crossing the British area, immediately to the north of lat. 52°, was insisted upon; and, although this barrier was probably broken through (in South Warwickshire) in the latter portion of that period, yet it divided, in the author's opinion, the coal-area into a north and a south portion, the latter showing a very different set of directions in the attenuation of its strata; the shales and sandstones thinning out eastward and the limestones in the contrary direction.

In conclusion, the author stated his opinion that the source of the Carboniferous sediments was in the ancient North Atlantic Continent, for the existence of which Lyell, Godwin-Austen, and others have argued; and he inferred that the shores of this *Atlantis*, composed principally of granitoid or metamorphic rocks, were washed on the west side by a current running south-west which drifted the sediment in that direction; and, on the other, by a current running south-east which carried sediment over the submerged British area.

Geologists' Association.—*February* 3.—Professor Tennant, F.G.S., President, in the chair. The following papers were read:—1. "On the Cretaceous Group in Norfolk." By C. B. Rose, Esq., F.G.S. The author, in an elaborate paper, described the general divisions of the chalk formation as exhibited in Norfolk, and following the arrangement proposed by the late Mr. Woodward, he divided the beds into Upper Chalk, Medial Chalk, Hard Chalk, and Chalk Marl. The Upper and Medial Chalk he stated to comprise the chalk with flints (the upper division of other geologists), and the author considers this distinction legitimate, inasmuch as the uppermost bed at Norwich contains organic forms which are not met with in the medial bed. The distinguishing characteristics of the several beds with their peculiar fossils, and the local limits of each formation were fully described, and the paper was illustrated by an elaborate section of the strata of the county.

2. "On the Plasticity and Odour of Clay." By C. Tomlinson, Esq. The author pointed out some of the most remarkable considerations in relation to this subject, such for instance as the fact that clay is only plastic up to a certain temperature; when heated beyond that point (which the author believes, from experiments performed by him, to be somewhere be-

tween 600° and 700° Fahr.) it loses its plasticity and acquires the property of rigidity. Moreover, having once lost its plasticity, this quality can never be restored to it by any methods known to science. Further, this property cannot be produced artificially. The constituent elements of pure clay may be combined in the proportions indicated by analysis, but the clay thus produced is not plastic. It is commonly stated that it is the alumina which confers upon clay its plastic property, but the author showed that pure alumina whether gelatinous, or after having been dried and ground up with water, never gives a plastic paste; nor can water be the cause, since melted glass and sealing-wax both possessed the property.

The author considered that the phenomenon may be due to a change in the molecular arrangement of the particles of the clay, and the consequent variation of the attractive force which holds them together,—the particles, under the circumstances under which clay is plastic, being nearer to one another, and the attractive force consequently greater, than under the circumstances when the clay has the property of rigidity.

As to the odour of clay, the author pointed out some difficulties in the way of the common opinion that alumina is the cause of this property, and suggested various considerations which might lead to the elucidation of this point.

Liverpool Geological Society.—*January* 14.—The papers read were "On the Connection between Physical Geography and Geology." By F. P. Marrat. "On the Geology of the Southern portion of the Isle of Man." By E. B. Franceys.

February 11.—"On Surface-markings on the Sandstone near Liverpool, supposed to have been caused by ice." By G. H. Morton, F.G.S. "A Brief Outline of the Geology of the country about Clitheroe, Pendle Hill, and Bromley." By G. H. Morton, F.G.S.

Manchester Geological Society.—*December* 31, 1861.—Mr. Binney exhibited a specimen of granite containing petroleum, sent to him by James Yates, Esq., of London. The specimen was obtained in 1818, and is mentioned in Aiken's 'Mineralogy' (1815, p. 60), so that its discovery is of older date than thirty years ago.

The papers read were:—

1. "On the Ventilation of Mines." By Mr. Joseph Goodwin. The author considered that it was not new principles that were required to prevent the loss of life that is taking place year by year in the working of the coal-mines of this country, but attention to the simplest, oldest, and most commonplace precautionary measures. Nor were the evils arising from explosions the only ones to be guarded against; it was alike a duty to pay attention to the sanitary state of the mines and to remove as far as practicable all the causes which are life-destroying, or that injure the health of the operatives. The phenomena of sudden outbursts of gas, and the velocity at which air-currents can be practically passed through the workings of a mine, were the chief topics of the paper.

2. "On the Self-extinguishing and Detector Safety Lamp for working Mines." By Mr. George Charlton, Mining Engineer.

January 28*th*, 1862.—Joseph Dickinson, Esq., F.G.S., President, in the chair. The following papers were read:—

1. "On the Bank Top and Hagside Pits; and the Proving of Faults." By Andrew Knowles, Esq. The Bank Top Collieries are about one mile from the town of Bury. One shaft or pit adjoins the East Lancashire section of the Lancashire and Yorkshire Railway, and is connected with it by a siding; the other is on the bank of the Manchester, Bolton, and Bury Canal. To the mine, the former pit is 130 yards deep, the latter

160. The mine worked is generally supposed to be identical with the Rushby Park of St. Helens, the Arley of Wigan, and the Royley of Oldham. The Hagside Pit is 760 yards to the deep of the one that adjoins the railway; being 280 yards in depth to the coal, and 300 to the bottom of the sump-hole. There is nothing of particular geological interest in connection with the mine, more than is usually met with in coal-mines We find *Anthracomyæ* in a layer, about four inches above the coal; and in the strata between the "two-feet coal" and the main bed, the author had seen several good specimens of Sigillaria. These strata vary from three feet to seven yards in thickness. The average thickness of the mine worked is four feet six inches. In giving his opinion on the proving of faults, the author confined his remarks to the kind commonly met with in the Lancashire coal-field. The faults generally met with in this county are dislocations, whether they are large or small ones; that is, the strata are broken up, and that the coal and other measures are often found the same on each side of the fault-vein. Suppose a fault is met with. It is easily known whether it is a down- or up-throw; if the former, the coal not unfrequently dips a little, for a short distance, before you arrive at it; if the latter, it oftener rises to it. But supposing you arrive, without any previous indication, at a fault, the direction is generally known by the way in which the striæ, or two sides of the fault-vein, commonly called the "slippy partings," point. If a down fault is met with, the direction is away from you; if up, you touch the vein first at the floor of the place where you are driving.

2. "The Ventilation of Mines." Mr. Joseph Goodwin. As the recent catastrophe at the Hartley New Pit has called forth the sympathy of almost every subject within the British realms, and appears at the present time to be exciting the minds of all engaged in the trade, the author thought it was not out of place to consider how far it is safe to trust to a bratticed shaft for ventilating coal-mines. The system of working a colliery with only one shaft presents an unfavourable aspect, viewed from whatever point it may be; but probably the system is more at fault, in so far as it affects the ventilation of a colliery worked upon this principle, and the risk to which it exposes both employer and employed, than if viewed from any other point. The author denounced this system through a thorough conviction that it not only immeasurably increases the risk to both employer and employed, but that, pecuniarily considered, no real advantage occurs from it of working a colliery.

FOREIGN INTELLIGENCE.

The Whales of the Antwerp Crag were made by M. Van Beneden the subject of his most interesting address at the last public sitting of the Belgian Academy, in which he gave a sketch of the important paleontological discoveries made during the recent excavations in the fortifications of Antwerp, and illustrated the subject by the interesting information he had acquired in a recent travel in Germany for the purpose of elucidating the history of the numerous fossil cetaceans that have been found in the soil of the environs of Antwerp. Drawing a comparison of the riches of the Musée Bourbon of Naples in its treasures of antiquities from Herculaneum and Pompeii, with the fossil treasures of Antwerp, he proceeded to narrate the geological history of that district. "At the very place," he said, "where to-day roar lions, tigers, and bears in cages barred with iron, in times of yore legions of dolphins and whales were 'blowing' freely, ploughing the surface of the sea with their broad tails, and quietly sporting without fear of man. These fossil remains are of a much higher antiquity than all the products of human industry. Man had not yet made his appearance at the period when the sea covered these latitudes; the earth was then neither sufficiently prepared nor sufficiently solidly established to receive the 'king of creation.' Between the present epoch and that time past when the soil which now bears the wonders of the city of Rubens reposed at the bottom of the sea, we find numerous and incontrovertible vestiges of an intermediate period when many great terrestrial mammifers held their sway.

"From the depths of Siberia to the basin of the Mediterranean and the Black Sea, two great pachyderms, the Mammoth and tichorine Rhinoceros, trod in great numbers the shallow waters and plains,* at the same time that the great bears so carefully described by Dr. Schmerling (in 1833) frequented the sombre caverns of Liége. The nearly complete skeleton disinterred two years since at Lierre amongst bones of rhinoceros, ox, deer, horse, and hyæna, belongs to this intermediate period.† . . . The North Sea had not then its present limits; England had not yet, perhaps, been subjected to that terrible convulsion which violently separated it from the Continent; and judging from the considerable number of bones which are met with in certain places in the present seas, these great pachyderms traversed freely and dry-foot from the Meuse and the Scheldt to the Thames and the county of Essex. . . . As I propose to speak of the fossil bones collected from the sand, otherwise called the 'Crag,' of the environs of Antwerp, and which forms a real catacomb of dolphins and whales, permit me to draw attention to the species which now visit our coasts, in order the better to judge of the differences which are revealed by a comparison between the present North Sea and the Sea of the Crag at that geological epoch. Who is there that, during the fine days of summer, reclining on the sand of the dunes or at the foot of the cliff, abandoned to his reveries, has not been struck with that majestic nature which, under a thousand different forms, spreads waves of life on the sea! Who has not asked himself,—This shore of to-day, is it like the shores of other days? These waters, have they always enclosed in their bosom the same fishes? What mean these petrified bones, these tusks of mammoths which the sea throws up sometimes along the coast? As the archæologist, arrested by the majestic ruins of Thebes or Palmyra, delights in evoking the remembrance of their peoples, and figuring to himself the forum and the temple filled with the dense crowd, so the naturalist sees the ancient seas roll their foaming waves on the dry land, the waters peopled with dolphins and sirens, star-fish and 'ear-shells.' . . . All the species, cetacean or fish, mollusc or polype, buried in those vast beds of sand, have disappeared from *our* seas, and even their analogues inhabit only much more southern regions.

"The *mise en scene* is the same as of old: flood and ebb produce the same effects; the surf causes the same ravages,—in a word, the decorations remain, but the actors are changed.

"The phenomena most apparent to the naturalist in comparing the pre-

* Of late the study of the species of the quaternary epoch in respect to their appearances and succession has made great progress. A remarkable memoir by M. Lartet has appeared on this important subject, and according to this learned paleontologist the cave-bears had disappeared before the appearance of the mammoths, and man was contemporary with these species. (See Ann. des Sc. Nat., 4me Série, t. xv., cah. iii.)

† Scohy, 'Considérations sur les Ossements Fossiles découverts à Lierre,' 1860; and 'Bulletins de l'Académie Royale de Belgique,' 2me Série, t. ix., No. 5.

sent sea with that of the Crag, is the rarity of certain species in modern times and their extreme abundance in times past. It is only at long intervals that we see now on our shores some stray dolphin or a whale that has wandered out of its way. The cetacean that we see stranded in our latitudes is generally an isolated individual, which its troop have rejected or the tempests have separated from its associates. It was not so when, in other times, the numerous species of the Crag sea lived; many of those great cetacea had there their regular stations, while others made periodic visitations. In respect to their abundance and regular migrations, one discovers even since the historic period very considerable changes, to which the rapacity of man perhaps has not been foreign.*

"It is known that in the ninth century the Basques . . . harpooned the whale in the Gulf of Gascony, and pursued it even as far as the North Sea. Different charters prove that associations of whale-fishers, known under the name of *Societas* or *Communio Walmannorum*, existed in the 11th century on the coast of France.† These fisheries were so successful in the Channel, that mention is made in these charters of the sale of the fresh flesh. Nowadays it is truly an event if by chance one of these great cetaceans presents itself in these latitudes. Cuvier, struck with this difference, thought that the whales had fled before man, and that these animals no longer found safety except amongst the reefs of polar ice.‡

"This explanation of the great naturalist, although generally accepted, does not, however, accord with facts. The whale of the Channel is not the same as the whale of the Polar circle. It is not without reason that for a long time my friend Eschricht has opposed the hypothesis of Cuvier; and the former, the learned professor of Copenhagen, has shown that the Icelanders knew perfectly, as far back as the twelfth century, these giants of the Channel from those of the North. In a manuscript of that distant period,§ the Iceland fishermen specified the characteristic differences of the two species.‖ . . If the whale pursued by the Basques is not the *Baleine franche* of the North—the *Mysticetus*—what is it then? Has it ever

* Amongst the migrations which have interested us, we could cite two species which visit regularly the Feroe Isles since the most remote period, and still make their periodic visitation. According to a legend of the country, a pagan giant, vanquished by a Christian, promised him for ransom and pardon to send him every year a bird and a whale which should be found nowhere else. The bird is the white crow, the whale the dogling or hyperoodon.—Eschricht, Comptes Rendus, t. xlvii.; July, 1858.

† Cuvier makes mention of these charters, which were communicated to him by the Abbé de la Rue. (See 'Ossements Fossiles,' 4me edit., t. 5, 1re partie, p. 74.)

‡ The illustrious *savant* could not speak with exact knowledge of the *Mysticetus*, or of the Northern whale, because he had never seen a specimen. At the present time even there is not a skeleton of this curious animal either at Paris or in London. There is known one example at Copenhagen, and a second has since been acquired by the Royal Museum at Brussels. The other chief portions of this whale known are, a fine adult skull at Kiel, another head at London, and the head of a young animal at Leyden.

§ 'Kong-Skug-Sio, Det Konglige Speil, den Konigligen Spiegel,' or 'Royal Mirror,' an Icelandic manuscript of the twelfth century.—B. (See also M. Reinhardt on the "franches" whales, 'Om Nordhvalen' (*Balæna mysticetus*, L.), in 4to, Kiöbenhavn, 1861.

* The Icelanders distinguish the two species of whale as that of the North (North Whale) and that of the South. The last bears on its skin white calcareous crowns, which the other never does. These white crowns are cirrhipedes, which develop and propagate themselves on the back of that marine monster. . . . Each species of whale has its peculiar cirrhipedes. Some have the *Coronula;* others the *Diadema;* and others again the *Tubicinetla*,—the last bury themselves several inches deep into the skin and the fat.

been seen by any naturalist? Is it the Southern whale in which the Dutch whalers have thought they have recognized their 'North-Caper'? Has it disappeared since this fishery was established, like so many other kinds which have been annihilated within historic times?* There is need of facts to dissipate these doubts; the best arguments do not suffice. But can one ever hope to find them for these delicate and difficult questions? In these uncertainties, zoologists, not knowing whether to think Cuvier right or the Iceland fishermen, were in great commotion some years since in respect to an event which happened in the Gulf of Gascony. This was in January, 1854. It is at this period of the year that the ancient whales arrive there regularly to take their winter station. A mother-whale, accompanied by its cub, made its appearance at St. Sebastian one day in January, and fortunately the young whale was captured. The Museum of Pampeluna made the acquisition of it. Eschricht heard this news at Copenhagen; nothing passed in the world of whales that he was not informed of. 'It is my Biscay whale,' said he; 'the species still exists.' He trembled at the idea that the treasure might escape him. He arrived at Louvain nearly at the same time as the letter by which he informed me of the news; announced to the Institute of France the motive of his passage to Paris;† arrived at Pampeluna, made his way at once to the coast, and buried himself in the midst of the shore in the study of the bones of the head and of the vertebræ of this precious relic. The victory was his. This whale differed completely from that of the North.‡ It was really a remnant of those ancient legions which once on a time visited these latitudes in numerous bands, and which have since deserted these places. On our coast the whales stranded since the beginning of this century have been far from numerous, and we could easily enumerate them. Several years since, . . M. de Selys-Longchamps mentioned them in his Belgian 'Fauna.' There are but two balenoptera; the one of Kessels, found dead at sea in 1827 by the Ostend fishermen.§

* We know that since the historic period many species have abandoned the centre of Europe, and that others have also completely disappeared. . . . The reindeer and elk have quitted the interior of Europe since the extinction of the mammoths. The *Dodo* and the *Alca impennis* have undoubtedly completely disappeared. We are fortunately not altogether certain of the latter. It is believed that the *Rythina Stelleri*, the singular sirenian of the Behring Sea, is equally lost; but we have had great satisfaction in seeing that the Museum of St. Petersburg has received a complete skeleton. Nordmann, 'Paläontologie Sued-Russlands,' Helsingfors, 1859-60, p. 328.

† 'Comptes Rendus de l'Académie des Sciences,' sitting July 12th, 1858.

‡ 'Sur les Baleines franches du Golfe de Biscaye,' in Comptes Rendus, 1860. In a letter dated from Copenhagen, Eschricht had the kindness to inform me of the result of his researches on the difference of these two species of whales. "The skeleton of Pampeluna has entirely occupied me," he wrote on the 18th May. "It is the most curious of any that I have met. It is nearly mounted, and the enormous difference between it and the *Mysticetus* surpasses all I had expected before my sojourn at Pampeluna. Figure to yourself," he added, "that it is not more developed than the skeleton of a *Mysticetus* of less than a year; the ossification of the vertebræ has not advanced beyond the transverse apophyses; and the arches, which are not even united on both sides, are still separated from the body, whilst the vertebral column is as large as that of a *Mysticetus* of three years and a half." Eschricht, 'Développement du questionnaire relatif aux Cétacés,' in 'Actes de la Société Linnéenne de Bordeaux,' t. xxii., 4me livr.

§ Van Breda, 'Eenige Bijsonderheden omtrent den Walrisch die den 5 November 1827 bij Ostende gestrand is,' in Algemeine Konst en Letterbode, 1827, 2e vol.

Vanderlinden, Bibl. Inéd. Nat. et Etrang., t. v., 1028.—'Bydragen tot de Natuurlische Wetensch.,' 4de deel, 1829.—Messag. des Sciences, 1329. Du Bar, 'Ostéographie de la Baleine,' Bruxelles, 1828.

and which, prepared as a skeleton with much care by M. Paret, after having visited during twenty years the principal towns of Europe, continues at the present time, it appears, its peregrinations in the New World. It is the *Pterobalæna gigas.* The other balenoptera belongs to the small species, which does not exceed thirty feet in length, and which has always forty-eight vertebræ; it is the *Pterobalæna minor* of Knox, or the *Pterobalæna rostrata* of Fabricius.* The skeleton preserved in the Zoological Garden of Antwerp belonged to an individual stranded on the coast of Holland, and is of a third species, the *Pterobalæna communis.*†

"The Academy will remember that we entertained it three years ago with the Dolphin *Globiceps*, found dead at sea by the fishermen of Heyst under very interesting circumstances. It was a mother, which at first they had taken for a barrel, and which was on the point of going down.‡

"It is the same animal which the Feroe islanders look out for every year with such great anxiety, and whose flesh is esteemed by them a delicious dish.§ The *Grindewahl*—for that is the name they give them—make their appearance in these isles with the thrushes and woodcocks elsewhere; with this difference, that the thrushes and woodcocks figure only on the tables of the rich, whilst the flesh of the grindewahl is the food of the poor. It is by thousands that they are taken every year; and one of the most curious spectacles which can be given to a sovereign is a fishery of the grindewahl in one of the fiords of Feroe, made in the presence of the King of Denmark when he visits these isles. But the most formidable of the cetaceans which visit our latitudes is the orca, or ork. We see it from time to time on our coasts. Two individuals of this dangerous species, a young and an adult female, were stranded in 1843–44 near Ostend, and an adult female was found dead on the strand in 1848. The ork is by far the most formidable of all the great marine animals; the colossal whale, even, is not exempt from his vigorous attacks; it is truly the consternation of all. Nothing is more curious than to listen to the tales of the fishermen of Greenland and Spitzbergen of the habits of these marine monsters. What violence in the struggle, what tenacity in the attack! One would think one was listening to the recitals of travellers in the deserts of Africa, narrating the gigantic struggles of the great mammifers, the terrible assaults made by the lions and tigers on the elephants, the buffalos, or antelopes. The first of August of this year, a fine male lost itself on the coast of Jutland. Intelligence was sent immediately to Copenhagen, and Professor Eschricht made his way to the place. He wished to know above all on what this animal had fed during its last hours; and he soon discovered that not without reason the ork is the terror of the seas. It contained in its stomach (one would hardly have supposed it) thirteen porpoises and fifteen seals! My learned friend searched with a feeling of horror whether amongst this frightful mass of victims he could not find

* This species comes regularly ashore on the coast of Norway. Near Bergen, they take them every year. Fabricius knew it well in Greenland, but he erred in giving it the name proposed by Linnæus, who did not know the whales. This example shows that it is not always the name of the first author which ought to be preserved. There exists a skeleton of this species in the Royal Museum of Brussels; another, of a young individual stranded at Ostend, is in the Cabinet of the University of Ghent; and a third, from Greenland, formed a long time ago part of the collection of the Catholic University of Louvain.

† Bulletin de l'Académie, t. xxiv., No. 3.

‡ 'Recherches sur la Faune littorale de Belgique (Cétacés).' Mém. de l'Acad. Roy. de Belgique, t. xxxii.

§ Comptes Rendus, t. xlvii., July 12, 1858.

some remains of a sailor. A fine species of ziphioid cetacean known to science under the name of *Delphinorhyncus micropterus*, or oftener as *Mesoplodon Sowerbiensis*, was stranded some years since near the port of Ostend. It still uttered groans when M. Paret, the naturalist of Slykens, arrived on the spot. This animal, rare everywhere, and of which but one complete skeleton was known, has furnished the subject of a fine memoir by our illustrious *confrère* M. du Mortier.* . . . Another species of the family of Ziphioids, which visits regularly the Feroe Isles, shows itself sometimes on our coasts. An individual was taken some years since, at Bergoluis, near Zierickzee, and described by M. Wesmael.† It is the Dögling, or the *Hyperoodon* of naturalists. A whole band was lost last year after bad weather on the coast of Jutland. It is this family of cetaceans which was most largely represented in the Crag Sea, and on this score it interests us in an especial manner. The porpoise is the only cetacean proper to our littoral ; and we are still ignorant if it be sedentary during the whole year on our coasts, or if it visits regularly other latitudes. Every year at spring-time porpoises enter the Baltic by the Sound in the pursuit of herrings, and they only go out again in December and January by the Little Belt, between Fionie and Jutland.‡ As we find them on our coasts oftener in summer than in winter, it is evident that our common cetacean does not belong to those which take up their summer quarters in the Baltic.

"We do not dwell on the whales in ancient times stranded in our latitudes. There is too much exaggeration in the statements of authors.

"We shall only mention the cachelot or potwall, which has appeared several times some centuries ago in our latitudes, and of which Ambroise Paré has given a very recognizable figure.§

* B. C. du Mortier, 'Mémoire sur le Delphinorhynque microptère échoué à Ostende,' Bruxelles, 1839, in Mém. de l'Académie Royale de Bruxelles, t. xii.

† Wesmael, Mémoires de l'Académie Royale de Bruxelles, t. xiii., 1840. This skeleton is deposited in the Brussels Museum.

‡ Eschricht, Comptes Rendus de l'Académie des Sciences, sitting of July 12th, 1858.

§ In 1189 a whale of extraordinary size was stranded at Blankenberghe;* in 1334 the fishermen of Ostend took a marine monster of forty feet in length.† But the most extraordinary fact is that in the winter of 1404 eight whales, mostly of seventy feet in length, were thrown on the flat sandy shore near Ostend by a tempestuous sea, and taken nearly all alive.‡ That which appears least doubtful, and here the species is indicated, is that in 1577 and 1598 two potwalls were cast ashore: one in the Scheldt, near Antwerp, and figured by Ambroise Paré;§ the other at Berchey, in Holland, and described by Clusius,|| who first figured this animal. He had seen the one stranded at Berchey in 1598, and another at Beverwyck in 1601; the former fifty-three feet long. Albert, on the authority of Cetus, speaks of two cachelots stranded in his time; one in Friesland, the other near Utrecht; and knew the *spermaceti*, or "blanc de baleine." The ancients do not mention it, and probably did not know the animal which produced it.¶ Piet Bor** makes mention of an infernal monster of eighty feet, stranded on the 1st of May at the Sluysche Gat, and which doubtless belonged also to the cachelots. This calls to my mind a band of thirteen young individuals, if I do not err, which lost themselves some years ago at the end of the Adriatic, and of which one head is preserved in the Museum of the University of Berlin.

* Montanus, Add. ad Histor. Guicciard., p. 150, ed. Amsterdam, 1646, fol.

† 'Délices des Pays-Bas,' t. iii. p. 15, 2d edit.

‡ Guicciardini, Descritt. di tutti i Paesi Bassi, fogl. 331, ed. de Plantin, 1588, in-fol.

§ Ambroise Paré, 25e livre de ses Œuvres.

|| Clusius in 1605.

¶ Cuvier, Ossem., vol. v. p. 329.

** 'Nederlandsche Oorlogen,' 31te boek, fol. 6, 4te deel.

"We see clearly from what has been stated that our seas are very poor in whales; we can easily count the individuals which have been stranded. But was it so in that ancient sea which deposited the red and black sand of the province of Antwerp?

"We shall remark that between the seas of two distinct geological epochs there existed. in respect to their great inhabitants, considerable differences, and these differences bear at once on the number of species and the quantity of individuals: *as* rare as they are rare now, as they were abundant then.

"If the chemical composition of the sea has changed like its inhabitants, we are still ignorant of it, but we shall not, perhaps, always be so. As Ehrenberg has pointed his microscope to the infusoria, and Herschel his telescope to the stars, Bunsen and Kirchhoff direct their scrutinizing prism over the entire world to find out its chemical nature, and they will soon tell us, doubtless, whether the Crag Sea contained the same chemical elements as the present ocean. May we not expect this from the *savants* who have noted gold and silver in the sun, and have determined the absence there of the most common metals of the earth, silicium and aluminium?

"We have already said, on other occasions, that the Crag Sea nourished such a great quantity of seals, dolphins, and whales, that their débris forms, in different localities, veritable ossuaries.* Bones of all dimensions are there thrown pell-mell; and we see clearly that the skeletons of these great cetacea have been, during a long time, the playthings of the water. At each tide, shreds of bones and flesh were swept backward and forward by the waves, until the soft parts were perfectly decomposed. The cetaceans only were thrown upon the greatest heights, during the highest tides; and they were sometimes buried in their integrity.†

"Independently of these legions of cetaceans, a great number of fishes frequented the same latitudes; but there are scarcely any other remains than those of the Selachian fishes that have come down to us. The most curious is the *Carcharodon megalodon*, which was not less than seventy feet in length, and for which an ox would have been only a mouthful. Teeth of the *Carcharodon* have been left in the Crag, and a very curious vertebra.

It is extraordinary that we find there so few remains of osseous fishes. "Perhaps we may find the explanation of the rarity of the ordinary fish in the fact that the ziphioid cetaceans predominated in that sea, and that the nutriment of these cetacea consists exclusively of cephalopodous mollusca. The great whales, as we know, feed only on the pteropodous molluscs, or on particular crustacea, both of small size.

"We shall not say anything of the shell-fish, nor the superb corals, which peopled at that epoch the basin of Antwerp. It is upon M. Nyst, whose conscientious labours are so justly appreciated at home and abroad, will devolve the task of some day entertaining you with these interesting animals.

"We should not always think that these fossil bones and their high value in a scientific point of view may not have been already appreciated by naturalists. For a long time they have been known. These bones have often been attributed to giants. Who knows if they do not even enter into the legend of the origin of Antwerp? Be that as it may, the

* 'Les Grands et les Petits dans le Temps et dans l'Espace,' Bull. de l'Acad. Royale de Belgique: 2e série, t. x.

† The cetaceans, of which the relics are found in such abundance at Saint-Nicolas, appear to be under these conditions. 'Ossements Fossiles découverts à Saint-Nicolas en 1859,' Bull. de l'Acad. Roy. de Belgique, 2e série, t. viii.

honour of having recognized the remains of these great animals is carried back to a learned physician of Antwerp in the seventeenth century, Goropius Becanus.*

"At the end of the last century, the Baron von Hupsch wrote upon this subject a very curious work.† But it is, above all, to Cuvier we owe the most remarkable work on the fossil bones of Antwerp. The great naturalist of the Museum had received at Paris many which had been exhumed at the time of the excavation of the Basin of Commerce, in the reign of the First Napoleon.‡

"Some years ago fossil bones of cetaceans were found in great numbers in other localities,—the Crag Sea seemingly having had a much more considerable extension than had been previously thought. In Holland, in the province of Gueldres, bones have been found exactly as at Antwerp; and moreover a portion of a cranium, which recently came from the Baltic,§ appears to have belonged to an animal that had a great analogy to our *Plesiocetes.* Similar bones have also been dug up in Russia, and described under the name of *Cetotherium.*‖

"A phenomenon of another kind, but equally worthy of remark, is a skeleton of a baleinoptera found in England, in the diluvium, at twenty-eight feet above the present high-water; and another discovered in Norway, near Fredericstadt, at 250 feet above the present level of the seas.**

"In spite of these inherent difficulties in the study of the fossil remains of cetacea, we have succeeded, however, in determining the greatest number. We have attained to reconstituting some of them tolerably completely.

"In the first place, then, we have found out that the great species of baleinides, or cetaceans with whalebones, had then many representatives. Some weeks since, an entire head of one of these great animals was exposed, but, unfortunately for science, it could not be preserved. We possess in great number the vertebræ of these whales from all parts of the body; fragments of ribs and of limbs—comprising the shoulder-blade; many portions of the cranium; the inferior maxillaries, nearly perfect; and, above all, the tympanic bones.

"But the family which is most richly represented in that ancient sea was the Ziphioides. We see them of all sizes. Of these we have, first, an animal near to the cachalots of the present day, and of dimensions equally gigantic. Another offers all the characters of the existing *Hyperoodon;* then we find numerous teeth singularly constituted, which we attribute to Ziphioides allied to *Dioplodon* and *Mesoplodon.* Lastly, some truly dwarf species complete this curious family, and certainly these did not exceed in size the smallest dolphins of the present creation.

"The Cetodonts, or the cetacea with teeth, had also many other representatives, approaching most nearly to the long-nosed species of the tropical regions. Two fine heads have been discovered at Vieux-Dieu, the perfect preservation of which is due to the intelligent and active care of the

* Goropius Becanus, 'Orig. Antwerp.'

† 'Beschreibung einiger neu entdeckten Versteinten.'

‡ Cuvier, 'Ossements Fossiles,' t. v., première partie, p. 352 (4to edit.).

§ Hensche and Hagen, 'Ueber einen auf der kurischen Nehrung bei Nidden gefundenen Knochen,' Schrift. der Phys. Œcon. Gesells. in Königsberg, Jahr i., Heft ii. He gives a list of the cetaceans stranded in the Baltic, and notices several fossil cetaceans.

‖ Eichwald, 'Die Urwelt Russland's,' St. Petersburg, 1840, livr. 1re, p. 25; Brandt, Institut, 1843, No. 205 et No. 419. Nordmann, 'Paläontologie Sued-Russlands.' The last is in course of publication.

** 'Stadstrath Hensche,' loc. cit. page 7.

Captain of Engineers, Cochetaux. All the bones are admirably preserved; and, if the teeth are detached from the maxillaries, we at least have the exact indication of their number, place, and size, by the disposition of the alveoles. These two heads belong to animals which ought evidently to form a new genus, characterized by thirty-two teeth regularly spaced in the middle part of the jaws.

"Finally, among the mammifers which inhabited that sea are also found littoral species; of the seals, some of which attained to grand proportions, we possess divers fragments of skeletons and of teeth, which leave no doubt of the presence of these singular amphibians in the ancient seas of these latitudes.*

"The Government, seconded by the intelligent zeal of several officers of engineers, has specially charged the Viscomte B. du Bas, to see to the conservation of these precious relics; and we shall have the occasion, we believe, to present a tolerably complete history of one of the most singular and most interesting of the antediluvian animals which have been discovered. We speak next of the Squalodon, and we shall enter into some details of the history of this curious group of fossil carnivora.

"Some years ago (1844) the Doctor Albert Koch returned from North America, with a rich cargo of fossil bones belonging to strange animals. They had been exhibited already in public before their departure for Europe. They were successively shown in the principal towns of Germany, at Dresden, Berlin, and Leipsic.†

"This exhibition made a great noise, and one can comprehend why it could not be otherwise. An animal more than a hundred feet long, having head of an extraordinary form, jaws furnished with teeth such as were not known, and which in spite of its immoderate length, bore two small pairs of limbs:—it was a gigantic serpent suspended before and behind by a pair of fins.

"Curiosity was raised to the highest point. The friends of the marvellous found in it ample food for suppositions of every kind, and the *savants* themselves did not know whether they ought to believe their eyes or their principles.

"Numerous papers were produced on the occasion. The American naturalists, in the first place, took this animal for a reptile and gave it the name of *Basilosaurus*.

"Three or four years after the discovery of these remains, the French and English zoologists (Dumeril, Buckland, and Owen) made of them on the contrary a mammifer; and Owen did not hesitate, after the examination of a fragment, to assign it to the walruses, proposing the name of *Zeuglodon*, which it still retains.

"In Germany, after the public exhibition of these numerous pieces, opinions were divided.

"In reality the vertebræ of several individuals had been grouped toge-

* Bulletins de l'Académie, t. xx., No. 6.

† For the title of the principal publications on these singular animals, see the 'Transactions of the American Philosophical Society,' 1834; 'Transactions of the Geological Society of Pennsylvania,' vol. i., Philadelphia, 1835; Transact. Geol. Soc. of London, vol. vi.; 'Comptes Rendus des séances de l'Académie des Sciences,' Oct. 1838; Proceed. Acad. Nat. Sciences, Philadelphia, 1845; Carus, Resultäte Geol. Anat. und Zool. Unters. über das unter dem Namen Hydrarchos von Dr. Koch zuerst nach Europa gebrachte grosse fossile Skelett. Dresden, 1847; De Blainville, 'Ostéographie,' 1840, livr. vii. p. 44; Karsten's und Dechen's Archive, 1812; Ann. Sc. Nat. iii. série, vol. v. 1846; J. Müller, 'Ueber die fossile Reste der Zeuglodonten von Nord-America,' in-fol. Berlin, 1849.

ther; the bones of the head had been placed topsy-turvy; of dorsal and lumbar vertebræ a disproportionately long neck had been formed, and *savants* of high reputation were completely led into error. Finally, on investigation it was found that the bones had been brought together from different localities, and that with the remains of several skeletons the collectors had tried to fabricate a single animal.

"Jean Müller boldly attacked the question, and was one of the first to show the grave anatomical errors which had been committed. He had commenced his observations whilst the skeleton was publicly exposed at Berlin; but he soon had the opportunity of studying it at his ease in his cabinet, the King of Prussia having purchased it for the Museum of the University of Berlin.

"A curious circumstance was related to me by Müller, in his laboratory at Berlin, when showing me the temporal bone of the Zeuglodon. Being asked whether the *Basilosaurus*, or *Hydrarchos* as it had also been called, was a reptile or a mammifer, Müller was going through the galleries of comparative anatomy, accompanied by some friends; he held the temporal bone in his hand to exhibit his views of the structure of the ear, and in talking the bone slipped from him, and was broken on the floor. All were in consternation! What a loss! A unique piece of such importance destroyed! They picked up directly the pieces with the greatest care, but what was the astonishment of the professor and those who surrounded him, when it was seen that the cochlea of the internal ear was exposed, showing its twist and spiral turns. An accident had transformed the bone of the ear into a fine anatomical preparation, and the demonstration of the nature of the animal was thus made. The *Hydrarchos* could only be a mammifer.

"In Europe, a short time after, a paleontological discovery not less important was made. Don Grateloup . . . discovered, in 1840, at Leognan, near Bordeaux, a fragment of the cranium, which he thought should be assigned to an animal belonging both to the fish and the reptiles, to which he gave the name of *Squalodon!**

"Since then, the remains of similar or allied animals have been discovered at Lintz,† in Upper Austria, by M. Ehrlich; in the environs of Montpelier; at St. Jean de Végas,‡ by Paul Gervais; and in Holland, in the province of Gueldres,§ by M. Staring.

* Grateloup, 'Description d'un fragment de mâchoire fossile d'un genre nouveau de Reptile (Saurien) voisin de l'Iguanodon,' Bordeaux, 1 Mai, 1840; Actes de l'Acad. des Sc. de Bordeaux, 2e année, 2e trimestre; De Blainville, 'Ostéographie,' t. vii. p. 44, 1840. Passing accidentally through Bordeaux that same year in company with the Viscount Felix de Spoelberch, on returning from a tour in the Pyrenees, I remarked to Dr. Grateloup that the *Squalodon*, instead of being a reptile or a fish, presented all the characters of a Mammifer allied to the dolphins, and I wrote on this point a letter from Bordeaux to M. de Blainville which the illustrious professor has reproduced in his 'Ostéographie.'

† Ehrlich, 'Eilfter Bericht über das Museum Francisco-Carolinum,' s. 13; Troschel's Archiv, Jahresbericht, f. 1850, p. 32, Berlin, 1851; Carl Ehrlich, 'Ueber die nordöstlichen Alpen,' Linz, 1850, p. 12; 'Geognostiche Wanderungen . . . Linz,' 1856, p. 81; 'Die geognostische Abtheilung des Museums,' p. 10; 'Beiträge zur Paläontologie,' Linz, 1855, p. 9.

‡ Gervais, 'Paléontologie Française.'

§ Staring, 'Versteningen uit den tertiairen leem van Eibergen en Winterswyk in Gelderland,' Bodem, van Nederland, ii. p. 216. M. Staring has recently made a re-survey of the localities where bones of the quaternary age have been discovered: Aperçu des Ossements fossiles de l'époque diluvienne, trouvés dans la Néerlande et les contrées voisines; extrait des 'Bulletins et Comptes Rendus de l'Académie Royale des Sciences,' vol. xii., Amsterdam, 1861.

"The *Squalodon* and the *Zeuglodon* evidently resemble each other in the singular conformation of their dental system. But what is the degree of their affinity? To what family do they belong? Or do they form a type completely lost? and, in the case of an affirmative, what place ought to be assigned to them?

"These questions, and many others, wait for solution; and it will be readily conceived what high value is attached to the discovery of some bones of the *Squalodon* in the Crag of Antwerp.

"We are fortunately now in possession of many important portions of the head, the extremity of the upper maxillary, the intermaxillary with its teeth, the posterior part of the palate, many fragments of the inferior maxillary, and other parts of the skeleton.

"Lastly, to make out every possible part of these precious relics, the Government has, at the request of the Academy, commissioned me to visit the principal Museums of Germany and Austria; and we hope shortly to produce a work containing a reply to these different questions. The museum which most interested us in our last journey is the Vaterländisches Museum of Lintz, which contains the most precious remains of the *Squalodon* that are known. They were deposited there by M. Ehrlich. Thanks to the intelligent and active care of that able naturalist, this Museum contains, moreover, other fossils of high interest from the basin of Lintz.

"We have found there two much-broken portions of the cranium of the *Squalodon*: knowing before the base of the palate, and possessing fragments of the jaws with the teeth, and moreover the upper maxillary, it was not difficult for us to reconstruct the head of this aquatic carnivore. The dental system of these animals is equally well known to us now, even to the principal differences the species present between each other,—at most only a doubt remains on the subject of one of the molars.

"We will say a word on its characters.

"The cranium is greatly depressed; the parietals form a part o. the cephalic box, and the frontal bones extend regularly forward and over the side, without being folded back (*refoulés*) by the nasal cavities, as in the true cetacea. The zyomatic arches are large, but incomplete. The teeth are of three kinds, but put on only two different forms; the incisors and the premolars are like the canines; six incisors are implanted in the bone of that name, and of these six incisors the two middle ones are directed forwards in the direction of the axis of the body, not like the sword of the narwhal, but more like the great incisors of the shrew-mouse. The canines are succeeded by five simple premolars, regularly spaced; then seven true molars with two fangs and a compressed and crenulated crown (chiefly on the hinder edge) complete this singular dental system.

"We have been able to convince ourselves, also, from the tolerably perfect head of the *Squalodon* at Lintz, that, contrary to our anticipations, the nasal holes are directed from back to front, and differed in this respect from the existing blowing-whales. In the latter we know the cavity of the nostrils rises straight up, or even slightly backwards, and that it is this direction which permits their spouting perpendicularly their columns of water, or rather of vapour, from their nostrils. If we wished to figure the *Squalodon* as the dolphins are commonly represented, it should be drawn ejecting columns of vapour obliquely forwards, and not upwards. We endeavoured to profit, also, by our sojourn in Germany, in learning what were the other inhabitants of the sea which nurtured the *Squalodon*, in order to compare it with our Crag Sea. There is in the same Museum at Lintz a cranium of the highest interest in this comparative study. All the posterior portion is tolerably complete. It approaches closely by its size to our commonest plesiocetes; but, in the conformation of the drum of the ear, in characters of the fragments of the inferior maxillary which had not been recognized, as also by the vertebræ from different regions of the body, this cetacean differed notably from all that the Crag Sea contained. We are able even to add, that it had nothing in common with the *Balænodon* of Owen.*

"The *Balænodon* of Lintz is rather a ziphioid, and we doubt much if the tooth which has been assigned to it belongs really to that animal. The tympanum of this pretended *Balænodon* indicates the existence of characters far removed from the whalebone-whales of the Crag, and ally it to the *Hyperodon* or the ziphioids. For the rest, we believe we have recognized, among the undetermined bones in the Museum of Lintz, fragments of the inferior maxillary remarkable for their height and their great flatness, and which leave hardly any doubt on the subject. Since our journey, this *Balænodon* has been designated in our manuscripts under the name of *Aulocete*, on account of the cranial furrow.

"In the same sea of Upper Austria is found also a delphinoid which is unknown to science; but unfortunately it is represented by a single tooth.

"In the fine Museum of Stutgart we have found yet two other remarkable cetaceans of the same sea, the *Arionius servatus* of H. von Meyer,† . . . and a new ziphioid that we hope soon to see described. The latter has the seven cervical vertebræ isolated; and the drums of the tympanum, still in place, are remarkable for their form, their large size, and, above all, for the great thickness of their solid walls. . . But of all the inhabitants of the seas of that age, undoubtedly the most interesting are the fossil sirenians known under the name of *Halitherium*. They inhabited the coasts, or rather the embouchures of rivers, which they could ascend son e distance at need. To judge of them by the numerous relics found in different localities, at Darmstadt amongst others, these strange animals inhabited in abundance the Sea of the Molasse, whilst the Crag Sea has not harboured any of their remains. In the present creation we see the sirenians chiefly in the tropical regions. The Senegal and the Amazon foster them abundantly. The finest skeleton known of the *Halitherium* is in the Museum of Darmstadt; it shows the pelvis and a femur, of which the extremity is lodged in a cotyloid cavity. We are pleased to learn that Dr. Kaup, by whose pains so many paleontological treasures have been connected together, proposes to model completely this important relic of the ancient world. The Sirenians lived together with the Squalodons in the Sea of Lintz; but it is probable that these bones at Darmstadt belong to individuals which had mounted high up the river, and which thus are found far from the other marine animals. It is possible, also, that the waters below which these sands were deposited at Lintz and Darmstadt were brought by two opposing streams, like the Rhine and the Danube of the present day. . . All the bones at Lintz have been found in a thick bed of coarse sand, situated immediately below the quater-

* Hermann von Meyer has described this head at Lintz under the name of *Balænodon Lintanus*, believing these remains ought to be placed with those which Owen had found in the Crag. But what we do not comprehend is that this learned paleontologist has been able to find more affinity between the *Balænodon* and the *Zeuglodon* than between it and the *Squalodon*. See also C. Ehrlich, 'Geognostische Wanderungen,' Linz, 1850, p. 83, pt. ii.–iv.; 'Beiträge zur Paläontologie,' Linz, 1855, p. 8.

† H. von Meyer, Arionatus Servatus, 'Ein den Delphinen verwandtes Meeres Säugethier,' N. Jahrb. 1841, p. 315; 'Palæontographica,' vol. vi., Cassel, 1856–58, p. 31, pt. vi.

nary strata, and known under the name of molasse. This molasse corresponds, without doubt, chronologically with the Crag, . .

"We will say in conclusion, that the Pompeii for us Belgian paleontologists is the geological basin of Antwerp. There a new world reveals itself to the attention of naturalists. Marine forms there alternate with terrestrial, and the species of the Brussels basin, of which the remains have been so carefully collected by the intelligent perseverance of M. le Captaine Le Hon, had long disappeared, when the Crag Sea was peopled with its new and curious inhabitants.

"To the fauna which has been buried in the clay of Boom and of Rupelmonde, and which is distinguished by its superb remains of marine turtles, succeeded a fauna of elegant cetaceans; after the appearance of these giants of the sea, the soil was prepared to receive the mammoth and tichorine rhinoceros,—to finish in that which alone could complete the grand work. Millions have been spent in clearing out ruins and passages; let us profit by the millions spent in the national defences and set ourselves to the study, not of temples and forums, but of sandy shores frequented of old by that old-world creation, so rich in variety of forms, so full of the power of primitive nature.

"Let us found in the capital a Belgian museum, and unite our efforts to those of the Government to preserve in the same locality all the treasures of our soil. The galleries of the Belgian Museum should be spread beside the strata—those leaves of the grand book of our country, and the mineralogical and paleontological collections located with the actual fauna and flora; and by the side of these products of the soil should be shown the *chefs-d'œuvre* of art and the marvels of industry."*

NOTES AND QUERIES.

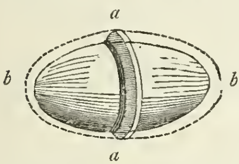
Travelled Boulders.—In the January number of the 'Geologist,' the editor states in his interesting article on "Some Fossil Fruits from the Chalk," that it is one of the features of the Magazine, "that matters not understood should be brought before the world in its pages." The following remarks, if they do not give information, may, at least, cause some intelligent reader to answer certain questions regarding what have been termed travelled or scratched boulders.

Sir C. Lyell, in his 'Principles of Geology,' has given a map, showing the extent of surface in Europe which has at one period or another been covered by the sea since the commencement of the deposition of the older or Eocene Tertiary strata. In his interesting and valuable description of this map, he remarks that the researches of Mr. James Smith, of Jordanhill, and others, among the northern deposits, enable us to discover the signs of a climate colder than that now prevailing. The Jordanhill here mentioned is a small estate in the neighbourhood of the city of Glasgow, not far from the river Clyde, and occupies a very small part of the area which can be proved by geological evidence to have been covered by the sea. The talented and highly respected proprietor above mentioned has published, in the Proceedings of the Geological Society, etc., descriptions of the arctic shells discovered by him when examining the till, or boulder-clay, on his estate and in the neighbourhood.

The scratched or rounded travelled boulders found in the till at Jordan-

* Bull. de l'Acad. des Sc. de Bruxelles.

hill give also, in my humble opinion, evidence of the existence, at one time, of a large mass of ice. The following sketch shows the strange manner in which granite can be smoothed and polished by natural causes. The sketch represents a granite boulder found several feet under the surface in the immediate neighbourhood of Jordanhill House, where it now lies not far from the garden-wall. The questions, What kind of force rounded this piece of granite, Does the fact that a portion of it—the vein almost in the centre—has not been removed, prove the said force to be ice? are questions not easily answered.



The vein of quartz, *a a*, has been left untouched by the force that has removed the granite originally on a level with it, *b b;* the force that has done this appears therefore to have been too weak to cut the vein of quartz. A stronger force may have previously cut the vein, or, what is more likely, the force that was polishing this travelled boulder, has sent it into a groove or furrow, which has prevented the vein of quartz from being lessened so quickly as the granite on each side of it.

I am inclined to imagine that this boulder and other similarly scratched boulders, brought to the surface in this neighbourhood, proves the existence of stones carried along upon ice, called in Switzerland the "moraines" of the glacier. Sir C. Lyell asserts that "all sand and fragments of soft stone which fall through fissures and reach the bottom of the glaciers, or which are interposed between the glacier and the steep sides of the valley, are pushed along, and ground down into mud, while the larger and harder fragments have their angles worn off." This quotation is taken from the last edition of the 'Principles of Geology.'—P. S. *Whiteinch, Glasgow.*

PERMANENCY OF VEGETABLE ORGANISMS.—The powder of a brick found on the site of the ancient Egyptian town of Eileithyia, examined under the microscope, proved to contain several fragments of animal and vegetable remains, among which those of eight species of plants were still in a state fit for specific determination. These eight species are in no way different from those at present growing and cultivated in Egypt and Nubia; a proof that a period of 3500 to 4000 years (the probable age of the brick under examination) has passed away, without any notable change taking place in the climate and vegetation of Egypt. More extensive examinations of similar materials may be expected to throw new light on the former flora of this seat of ancient culture.—PROF. UNGER, *Imp. Acad. of Science, Vienna, Jan. 9th*, 1862.

EARTHQUAKE PHENOMENA.—Dear Sir,—It is with some reluctance I venture to trouble you with an inquiry, but I know of no other from whom I could expect a reply which would be of equal value to me.

1. Suppose the direction of earthquake undulation were from east to west, would there be any probability of a valley or deep chasm being formed at right angles with the direction of the earthquake, *i.e.* from north to south?

2. Would it be probable that earthquake waves would run parallel with the mountain systems with which they were associated?

3. Suppose an earthquake to emanate from a given point, would there be a probability of its undulation extending in opposite directions from that point?—SUBSCRIBER.

1. Earthquake undulations (*i.e.* shocks) are incapable of forming valleys or deep chasms, by their direct action, at all.

Whatever chasms or fissures are produced are due to "secondary actions ;"—viz. to land-slips, or dislocations of rocky masses by gravitation, operating upon shaken country.

All such are in directions on the surface tending towards transverse of shock.

2. Earthquake shocks traverse furthest and most powerfully in the axial lines of mountain chains, and *vice versâ*, by reason of the fact that in the former lines the rocky masses are most solid and homogeneous.

3. Every earthquake emanates from a centre, which is practically a point or line, or *small* area or surface ; and the waves of pulse, necessarily, are propagated in all directions outwards from such centre of impulse, therefore in opposite directions.

We should suggest to our correspondent to study Mr. R. Mallet's papers on, 1. "The Dynamics of Earthquakes," Trans. Roy. Irish Acad. 2. The article "Earthquake Observations," by the same author, in the 'Admiralty Manual.' 3. Mr. Mallet's first and subsequent reports on "The Facts of Earthquakes," Trans. Brit. Association.

EARTHQUAKE-SHOCKS were felt at Cosenza (Calabria Citerior) on the 14th October, and at Ravenna on the 16th October last. On the 29th, a waterspout passed over Rome, causing much damage; the day after there occurred a violent tempest, and the magnetic instruments were greatly agitated. M. Alexis Perrey, Professor at Dijon, who for many years has furnished an annual statement of the shocks experienced by our globe, has sent to the Royal Academy of Belgium, a new "Note sur les tremblements de terre en 1859."

PLESIOSAURUS IN CHILE.—A caudal vertebra of *Plesiosaurus Chilensis* has been transmitted to me for identification by W. Bollaert, Esq., F.R.G.S., from San Vicente, near Talcahuano, in the neighbourhood of Concepcion, Chile. This species was founded by Gay (Historia fisica y politica de Chile), on various vertebral bones, which were found at the small island of Quiriquina, off Cape Talcahuano, in the Bay of Concepcion. The vertebra from San Vicente appears to present no specific difference from the *Plesiosaurus Chilensis* of Gay. A fragment of paddle-bone was found in the same locality.—CHARLES CARTER BLAKE.

SAUROID REMAINS.—Professor Agassiz, in a letter to Dr. Silliman,* describes some new Sauroid remains of very great interest, discovered by Mr. O. C. Marsh, a student of Yale College, from the coal-formation of South Joggins. These are two vertebræ, which have excited Professor Agassiz's interest in the highest degree. He says, "I have never seen in the body of a vertebra such characters combined as are here exhibited. At first sight they might be mistaken for ordinary Ichthyosaurus vertebræ; but a closer examination soon shows a singular notch in the body of the vertebra itself, such as I have never seen in reptiles, though the character is common in fishes; we have here undoubtedly a nearer approximation *to a synthesis between fish and reptile* than has yet been seen. . . . The discovery of the Ichthyosauri was not more important than that of these vertebræ; but what would be the knowledge of their existence without the extensive comparisons to which it has led? Now these vertebræ ought to be carefully compared with the vetebræ of bony fishes, with those of sauroid fishes, of selachians, of batrachians, of the oolitic crocodilians, of the newer crocodilians, of the ichthyosaurians, and of the plesiosaurians, and all their points of resemblance, and difference stated ; because I do not believe there is a vertebra known thus far, in which are combined features of so many vertebræ in which these features appear separately as characteristic of their type."

* Published in the 'American Journal of Science and Art.' January, 1862.

New Canadian Lower Silurian Fossils.—Mr. Billings has described, in a bulletin recently issued (Montreal, November, 1861), the following new species from the Potsdam group (Primordial zone), at Straits of Belle Isle, north-east coast of America:—*Palæophycus incipiens*, *Archæocyathus atlanticus*, *A. Minganensis*, *Obolus Labradoricus*, *O. chromatica*, *O. cingulata*, *Conocephalites miser*, *Bathyurus senectus*, *B. parvulus*, *Salterella rugosa*, *S. obtusa*, and *S. pulchella*.* From Vermont:—*Palæophycus congregatus*, *Orthisina fistinata*, *Camerella antiquata*, *Conocephalites Adamsi*, *C. teucer*, *C. arenosus*, and *C. vulcanus*. From rocks of the age of the Trenton, Chazy, and Black River Limestone:—*Eospongia Roemerii*, *E. varians*, *Astylospongia parvula*, *Lingula Perryi*, *Lituites Fanisworthi*, *L. imperator*, and *Ampyx Halli*.

The new genera are *Eospongia*, *Archæocyathus*, *Obolella*, and *Salterella*. The second includes small Brachiopods allied to Obolus (of Eichwald), but differing internally. The fourth is for a group of small conical bodies, possibly Pteropoda, and related to *Theca*, Morris, and *Puginuculus*, Barrande.

Carboniferous Beds of Dinant.—M. E. Dupont, a young naturalist, has collected an immense quantity of fossils from the carboniferous limestone of Dinant. His notice, communicated to the Belgian Academy, commences with the description of twelve localities, Celles, Hayont, Furfooz, Fossés, Freyr, Pauquys, Matignolles, Flavion, Corenne, Yves, Anseremme, and Awagne, and is accompanied by lists of the species most common in each locality. To it is appended a table showing the number of species met with in each of those localities, and the names of those which have been determined. Two hundred and seventy described species belong to 57 genera and 8 classes, and are from localities hitherto little known; while 255 others, belonging to 36 genera, are probably new species, by which our paleontological records will be enriched. The labours of M. Dupont, moreover, make apparent a very remarkable fact in Natural History, namely, the difference of the animal populations in very near localities at the same epoch, and on a ground-bottom of the same nature; for although the author only occupied himself with a district not more than eight leagues square, and has confined his investigations to the calcareous rocks of one geological stage—the Calcaire de Tournay—each of these twelve sections presents a fauna with peculiar characters.

Duties of Mineral Agents.—Many works on the improvement of estates treat fully on agriculture and forestry, but all either wholly neglect or only cursorily touch upon the mineral resources.

The 'Dublin Quarterly Journal of Science,' for January last, contains an excellent article "On the Duties of Mineral Agents," in which there is a variety of useful, practical information. The subjects treated are,—1. The Mineral Agent's Relations with the Mine-Lord. 2. Mineralogy. 3. Table of Characters of Ores. 4. Mining Geology. 5. Mineral Chemistry. 6. Mine-surveying. 7. An Appendix containing Forms of Take-Notes, Mining-Leases, and Licenses, etc.

Saurian Remains in the Jura.—M. Chepard, one of the engineers of the railway now constructing in the vicinity of Poligny, has noticed in the 'Sentinelle du Jura,' the discovery, in making one of the cuttings for the line, of the remains of a large Saurian, which, from the dimensions of the bones, he considers to have been from thirty to forty metres (?) in length. The remains consist of three claws of from eight to twelve centimetres in length, several phalanges with fine articular surfaces, a part of

* He has also identified from the same place, *Scholithus linearis* and *Barrandia* (*vel Obolus*) *Thomsoni*, and *B.* (*v. O.*) *Vermontana*.

the tarsus and metatarsus, two vertebræ, and various fragments. "These remains," he says, "lay in the upper strata of the Keuper, visibly overlapped by the Lias. This formation has hitherto been considered as devoid of organic remains in this country (France), where it contains gypsum and rock-salt. Nevertheless, some years ago, M. Pidancet, a geologist of the Franche-comté, found in these same strata large bones, which he deposited in the Museum of Besançon, and which he considers as belonging to the same species. A few months ago, while opening a ditch for the railroad near Domblans, a similar fragment was found; and M. Lauckardt, one of the employés, has seen also at the same place other bones much larger, which he could not displace on account of their fragility.

Mammalian Remains.—M. Froment, the Mayor of Saint-Lothaire, has found bones of mammoth and deer in a bed of sand and marl containing boulders of quartz and numerous fragments of terrestrial and freshwater shells.—'Sentinelle du Jura.'

Nodular Bodies from the Crag.—Sir,—Could any of your readers inform me as to what causes certain bodies of this shape in the

Red Crag of Suffolk? I have met with them in great numbers along the cliffs at Bawdsey. They are made up of the same materials as the rest of the crag, but seem to be harder and contain more oxide of iron. They are hollow in the middle, and measure from an inch to a foot in length. Their origin, perhaps, is the same as the Sabella tubes mentioned in a former Number by Mr. Brent. They are exposed only by the action of wind and water on account of their superior hardness. I should be glad of any information concerning them, however small.—I remain yours, etc., Voluta.

[We handed this query over to a correspondent, who pondered over the reply to be given on the origin of these mystical bodies until he fell asleep and dreamed that at a considerable outlay of time, trouble, and expense, he had submitted it to various competent authorities, and by special trains, electric messages, etc., had been favoured with the following answers:—

"Sponges," J. S. B. "Annelid-tubes," J. W. S. "Cephalaspid tails," G. E. R. "Casts of tree-roots," C. B. "Lightning-tubes," G. D. G. "Effects of Water-spouts," J. T. "Elongate-ovate Crystalloids," H. C. S. "Alveolinæ," W. B. C. "Ovoid bodies of Teredines," N. T. W. "Nests of Entomostraca," T. R. J. "Horn-cores of Bos," H. F. "Derived fossils from the Coal" and "Casts of bore-holes of Saxicava, in place," J. M. "Fossil wasp-nests," I. O. W. "Coprolite of a Gorilla," R. O. "Not a Coprolite of a Gorilla," J. E. G. "Cases of Caddis-worm (Phryganea Hercules)," H. T. S. "Joint of Cragocrinus," E. W. "Fœtal Whales," T. H. H. "Casts of Swallow-holes," J. P. "Objects of Human Industry, such as rusty spikes, tenpenny nails, marling-pikes, sounding-leads, or such like," B. de P. "Prochronic Tailor-birds' Nests," P. G. "Darwinian Eau-de-Cologne Bottles." F. W. H.]

Geology Briefly Explained.—The following admirable and succinct epitome of our science, in use by Professor King, at Queen's College, Galway, will be found very useful by many of our younger readers, and for lecture purposes by our elder ones.

Definition of the Science.—Geology (from *ge*, the earth, and *logos*, a discourse) treats of the nature and order of arrangement of the rocks composing the crust of the globe; of the physico-geographical changes which its surface has undergone; and of the various plants and animals with which the lands and waters of by-gone periods have been tenanted, as well as the order of their creation. (The last section is termed paleontology, from *palaios*, ancient, and *onta*, beings.)

It is necessary to mention that geology throws no light on the origin of the world, or on the nature and state of the materials occurring beneath its crust, or on its condition anterior to the setting-in of ordinary physico-geographical agencies—those are hypothetical subjects.

The following are some of the principal geological deductions:—

1. The rocks forming the known portion of the crust of the earth are of two kinds, as regards the origin of their present condition. One consists of masses which have been subject to a high temperature; and the other of materials deposited by the agency of water. They are respectively termed *Igneous* and *Aqueous*. Principal Igneous rocks: granites, syenites, porphyries, diorites, felstone, basalt, obsidian, etc. Principal Aqueous rocks: limestones, sandstone, shale, slatestone, salt, gypsum, marl, chalk, etc.

2. The formation of Igneous and Aqueous rocks has been going on from an immeasurably remote epoch, and still continues,

The existence of some kind of Igneous rocks in a refrigerated and consolidated condition, anterior to the formation of Aqueous deposits, can only be hypothetically assumed.

3. Certain Igneous rocks, as granites and the like, extend, *en masse*, below the surface of the earth to unfathomable depths; and wherever observed in contact with Aqueous rocks, they form the foundation of the latter; others, as basalts and lavas, have been ejected from great depths; and they generally occur overspreading other rocks.

The doctrine of the Igneous origin of granite and allied rocks has been much contested of late; there is little doubt, however, of their having been subject to a high temperature (see 6th deduction).

4. Aqueous deposits, occurring nearly everywhere, and often several thousand feet in thickness, have been derived from previously existing Igneous rocks, or from prior-formed deposits of their own class, through the mechanical and chemical action of atmospheric agents, springs, rivers, lakes, and seas. In this way, huge mountain-masses have been worn down (*denuded*), and valleys excavated; while their materials have been transported to the mouths of rivers, or disseminated over the bottom of lakes and oceans. The remains of plants, corals, shells, and other organisms (*fossils*) frequently enter into the composition of Aqueous rocks: sometimes beds are entirely made up of such remains.

5. Aqueous rocks, with few exceptions, have been slowly and gradually deposited in more or less horizontal beds (*strata*);—the order of superposition of the beds being the order of their successive formation; while their relative position denotes their relative period of deposition in the scale of geological time.

6. Subterranean heat and heated vapours, in many cases emanating from proximate igneous sources, have frequently penetrated deep-seated Aqueous rocks, producing in them molecular re-arrangements, and a more or less crystalline structure, or a change of chemical composition; thereby obliterating many of their original characters, and otherwise *metamorphosing* them. List of Metamorphic rocks: gneiss, mica schist, hornblend schist, quartz stone, statuary marble, etc.

Possibly all known Igneous rocks were originally Aqueous deposits that have been completely melted.

7. The surface of the earth has repeatedly undergone both slow and sudden upheavals and depressions. The former movements have raised wide-spread horizontal beds from the bottom of seas, often several thou-

sand feet above their original level, throwing them into high angles, as well as dislocating, fracturing, squeezing, and crumpling them: in this way, vast continents and mountain-chains have been formed. On the other hand, movements of depression have plunged beds far below their original level. Both kinds of disturbances have often been followed by extensive climatal changes, which have materially affected the life-system of our planet.

8. Vegetable and animal life has existed on the earth during an immense and undefinable period.

9. The plants and animals, whose remains are entombed so frequently in Aqueous rocks, have in general lived while the deposits containing them were in process of formation.

10. Successive creations and extinctions of plants and animals have taken place; so that, of the innumerable kinds (*species*) which have been in existence, only a comparatively small number is now living.

11. The life-system of our earth, in its various phases, has undergone "an advance and progress in the main."

REVIEWS.

Works of Julius Schvarcz, Ph.D.

1. *A Fajtakerdes Szinvonala három ér elött.* Pest, 8vo, 1861.
2. *Földtani Elméletek a Hellénségnél nagy sándor Koráig.* Pest, 8vo, 1861.
3. *Recherches sur les Théories géologiques des Grecs. Mémoire présenté à l'Académie des Sciences.* Vienna, 8vo, 1861.
4. *Lampsacusi Strato, adalék a tudomány történetehez.* Pest, 8vo, 1861.
5. *La Géologie Antique, et les Fragments du Clazoménien. Mémoire présenté à la* 28e *Session du Congrès Scientifique de France.* Pest, 4to, 1861.

It is with much pleasure that English geologists and paleontologists receive the intelligence that the controversy on the Origin of Species, carried on with increased vigour and animosity since the publication of Mr. Charles Darwin's deservedly esteemed work, has spread its exciting influence as far as the base of the Carpathians. Dr. Julius Schvarcz, a learned Hungarian, has recently published the works the titles of which we give above, and which embody the matured reflections of the most advanced palæontological school. This gentleman's works are published in the Magyar language; we believe that it is the first time that this ancient Ugrian dialect has been used to disseminate the principles of Natural Selection. The Age of Man, his contemporaneity with the extinct animals, the Abbeville discoveries, and the distribution over the surface of the globe of fossils monkeys, are all discussed in these works with an erudition surprising to English geologists, who are not prepared to find that the warfare carried on in the Zoological Section of the British Association in 1860 attracted attention in Hungarian scientific circles. The principles of Dr. Schvarcz seem ultra-transmutationist. He dates the creation of man to a period far transcending in remoteness the historical period, and endorses the opinions of Sir C. Lyell and Mr. Darwin. The most interesting work of his is that one (*Recherches sur les Théories Géologiques des Grecs*) in which he strives to demonstrate that the volcanological theories of modern geologists were anticipated by the early Greek authors. This work is entirely written in the Greek language, with which Dr. Schvarcz seems more familiar, we fear, than many of our most fervent labourers in Geology. "The theory of Progressive Development was warmly adopted and sustained by nearly all the ancient naturalists." This is consolatory to those who believe with Professor De Morgan that "for a science to become respectable, it is necessary that it should be founded by somebody whom nobody ever heard of, and whose works nobody has ever read." It is impossible, however, that the classical writers could have been possessed of the fundamental truths of geology by any other method than an *à priori* guess. We are positively afraid that if Dr. Schvarcz demonstrates that our progressive development theories are due to the comprehensive generalizations of Empedocles, some of the less philosophical hypotheses of the nineteenth century may also claim classical descent, and we cannot forget that Mr. Gosse's 'Omphalos' was anticipated in the time of the author of 'Hudibras.' However this may be, we cannot fail to render justice to the classical and geological acquirements of Dr. Schvarcz. He writes upon a subject "*nemine antea trito solo*," and with the exception of the late Professor Lassault, and Englishmen are now proud to add Sir George Cornewall Lewis, no writer has hitherto ventured to discuss questions fraught with such deep interest to the geologist, paleontologist, antiquarian, and classicist. We cannot forbear remarking that the beauty of the paper and typography of these voluminous Hungarian works, might do credit to nations more familiar with scientific requirements.

On the Tenby Bone Caves. By a Pembrokeshire Rector.
London: Kent & Co.

A small unpretentious pamphlet, containing a great many valuable facts and suggestions, as the following extracts will show:—

"Among all the wonders that the prevailing study of the earth's construction has brought to light, there is not one more striking than the presence here in England of great quantities of the bones of wild animals, known to inhabit tropical regions, which are found collected together in certain natural caves.

"At Tenby the fact appears in its most striking aspect; for such caves occur, and such bones have been obtained from them in Caldy Island. Now to suppose that herds of elephants, and hippopotami, and families of lions, tigers, and hyænas, could have lived and been sustained on a small island which is all but a mass of solid rock, is as impossible to imagine as that all the human inhabitants of the earth should find room to dwell there together.

"Be the answer what it may, here, beyond all doubt, are the bones of these creatures, taken from certain caves in Caldy Island, and in the mainland; some from 'the Oyle,' on a spur of the Ridgeway; and quantities from caves in Gower, and elsewhere. No less than 1100 horns of deer, mostly shed horns, have been lately exhumed from one cave in Gower only.

"The first of these caves . . . was discovered about twenty years ago by the quarrymen in blasting the cliff overhanging the sea on the north face of the island. It had no external opening at that time apparent. The walls were vertical, or nearly so; the strata being . . . perpendicular to the plane of the horizon. This cave was formed by a portion of the stratum, of considerable thickness, having disappeared at the place. Both the walls and the roof have since been removed by the quarrymen, and transported in the routine of their trade to Ilfracombe or Barnstaple ; so that no cave exists there now ; and the old earthy floor which contained the bones . . . is covered with soil and fragments of the blasted rock.

"Bones of the following animals were extracted from it :—Mammoth (*Elephas primigenius*), rhinoceros (*Rhinoceros leptorhinus*), lion, or tiger (*Felis tigris*), hyæna (*Hyæna spelæa*), bear (*Ursus spelæus*), horse (*Equus caballus*), ox, deer, wolf, fox—in short, the usual cave osseous remains of extinct, together with bones of pigs, sheep, and other recent animals, some identical with those which still inhabit the district. There also were found bones of fish, and dorsal spines of a species of ray. The elevation of this cave is upwards of 100 feet above the sea, and some of the bones in this collection show the same teeth-marks described by Buckland on those of the Kirkdale caves. Several have been gnawed by larger animals, and some bear marks as of the teeth of a rodent, some rat perhaps.

"The circumstances of this cave in general, and of some of the bones in particular, did not confirm, but rather contradict, the conjecture that it had once been a den of hyænas, by whom they were collected together. Hyænas' bones lay about precisely in the same state as the others. The whole seemed to have been forcibly carried into the cave by the action of water. Some of the bones were wedged into the fissures of the rock at the cave's ends, just as pieces of drift-wood and wreck are observed to be on the shore beneath. Even had the dung of the hyæna been observed here, as in those caves described in the 'Reliquiæ Diluvianæ,' and in Dr. Falconer's report of the ossiferous caverns in Italy, the inference would have been hasty, and probably altogether wrong, that it therefore had been an hyæna's den. The hyæna is by nature a bone- rather than a flesh-eating animal: the dung-balls consequently are almost entirely formed of phosphate of lime, and are so hard that they resist the temporary action of water almost as well as the bones themselves—perhaps, being round, even better. Moreover, if these cave-dwellers, which live in pairs and are not gregarious, follow the habits of canine animals, and of the badgers and foxes which abound still in this part of the kingdom, they would instinctively have sought external, and even distant places. Dogs are notorious for their cleanly habits in respect to their sleeping-places, when they are not chained up ; and badgers retire to some place distant from their holes, and to that same place every night, till at length the ground even glitters in the sunshine with the elytra of the beetles, chiefly the *Scarabæus stercorarius*, which in summer-time forms their principal food, as earth-worms do in the winter.

"The impression of the writer of this notice is, that all these ancient bones were drifted into the cave by the force of water, after they had been gnawed and mumbled outside of it, and that the dung-balls of the hyæna were drifted in with them. Careful observers will have noticed how water-floods collect together into the still places animal remains and light substances at all times.

"We may account for *the filling* of these caverns in more ways than one. There are in this neighbourhood, and in other parts of England, at this moment, certain holes and natural openings in the earth, particularly where the mountain-limestone lies near the surface, into which rain-torrents discharge themselves, thick with the red mud, and with lighter substances and small stones, which they bear along down the watercourses leading to them. These watercourses formed many of the ancient byeroads and lanes of the country. There is one so situated that has engaged the writer's attention in flood-time for more than twenty years ; nor is the cave yet filled to which it doubtless belongs, if we may judge from the fact that it still continues to receive the winter streams of muddy water. This hole is double, and each opening not more than a foot or eighteen inches in diameter.

"Or, again, there might have been anciently some lake in the vicinity of this cave . . . to which these animals resorted nightly to quench their thirst, and bathe their unwieldy bodies. On its shores many would perish, some from old age, some from weakness induced by long journeys, especially in times of drought; the mud through which they had to struggle to the life-giving wave would be too much for them; they would be 'stagged,' to use the common term applied to horses and cattle so circumstanced in the lowlands of . . . Essex and elsewhere; some would become the prey of other animals. . . . Then, when the lake became enlarged by winter floods . . . many of these bones might be forced into the cave, and so preserved.

"At the time *this* cave was first discovered, geology had not so far progressed as to suggest the probability of finding human remains, which therefore were not noticed if present: neither did any flint weapons *here* attract attention.

"But when new opportunities of examining caves occur, as they are likely to do at Caldy Island, and at Lydstep, the examination should be conducted with much care, and reported with the greatest fidelity. Every circumstance is worthy of note: human bones may be found deep beneath the stalagmitic floor, and surrounded with the bones of extinct animals; but if it is forgotten that man in rude times was accustomed to *bury* in such places, and the state of the soil and surface, whether disturbed or otherwise, be not considered, of course false inferences will be drawn.

"As to the junction of Caldy with the mainland, it was distinctly remembered by old labourers twenty years ago, that at very low tides carts used to cross from Giltar to St. Margaret's; which latter island was connected with Caldy in such a way as to be also reached by carts, if we may infer as much from the remains of a road there.

"The vale of St. Florence too, it may be worth recording, appears to have recently undergone considerable changes of level. There is a place on the hill-side, halfway up that ancient estuary, still bearing the name of 'The Old Quay.'

"Let us look around us as we stand on the Castle Hill—or rather think what meets the eye of the mind from that elevation, at all points. How many remains of terrestrial vegetation are exposed to view by the equinoctial tides all around the coast. They occur, for instance, at Caldy in front, at Portclew to the right-hand, and at Amroth to the left; indeed, everywhere stumps and prostrate limbs of the oak and fir, not even greatly altered in colour internally, are constantly to be seen; together with the remains of a thick growth of underwood, the hazel roots yet retaining about their forks the very nuts that grew upon the branches. These cannot be very old: the shore then must recently have sunk beneath the sea in which these stumps stand rooted. Have we here the vestiges of those ancient forests we were looking for just now, in which the animals roamed, whose bones filled the caves we are describing? And did such areas as Broadmoor, and Kingsmoor, and some of the water-levelled valleys that terminate in the sea hereabouts, form the beds of those great lakes and rivers we were just now inquiring after, in which they wallowed? One thing is certain, that in dredging among these stumps in the bay the horns of ancient deer, corresponding with those of the cave deposits, are found; as in like manner the teeth of elephants are frequently dredged up on the

Norfolk coast; whole trees, capable of being used for building purposes, are dug up in the adjoining valleys.

"A question here suggests itself: Have not the students of these pleistocene strata neglected a little too much the written documents still in possession of the descendants of the ancient inhabitants of the country—the Welsh, or British, strictly so called? Of the Cantrev-y-Gwaelod there is not only a general tradition, but even the names of certain of the 'hundred overwhelmed towns and cities,' of the harbours, and of the eminent men who governed the district, are still preserved in the poems and triads which have been collected and published in the 'Myvyrian Archaiology,' and elsewhere. . . . All this then seems to suggest the possibility that the time when the animals lived here, whose bones are collected in the caves of Tenby, may not have been very long ago; and though it is not intended to imply that these extinct animals lived here in England within the modern historic period, much less at the time of the subsidence of the bay of Cardigan, about the year A.D. 500, yet may not those recent subsidences of the land be but the continuation of that action which separated us from the continent, and examples of the way in which that separation was *last* effected?

"A very brief notice of the *second cave* at Caldy, chiefly to record the discovery and site of it, will be sufficient, because when it was broken into for the first time, about two years ago, the quarrymen shovelled the surface bones, of which there were a good many, into the sea, and it shared after a little time the fate of the first cave, except that the floor is said to be still intact. A few bones and teeth have however been preserved.

"Of the *third cave*, perhaps the particulars at this time will be most interesting, because it contained, with the remains of some of the carnivora mentioned above, flint implements of human construction.

"This cave is situated on the mainland, and has a large open entrance always known to the inhabitants by the name of 'the Oyle.' It runs far into the rock, and is easily entered to the distance of forty-eight yards, and further with a little difficulty. It was first examined archæologically, about twenty years ago, by Major Jervis, and a brother officer. Three celts were dug up, two of stone, and one of metal. During the present year a somewhat careful examination was made of the contents of the water-washed earth at the bottom of one of the chambers which constitute the cave, and which chambers alone contain any deposit, for the narrow parts are bare to the rock. Teeth of the bear were obtained, with a great quantity of the bones of recent animals. Here also were fish-bones, mixed with such modern littoral shells as the *Patella*, *Cardium*, *Purpurea*, *Capilla*, *Mytilus*, *Littorina littoralis*, *L. litorea*, *Natica monilifera*, etc., most of which, it is worthy of notice, are also found in the raised beaches which appear at heights above the sea, from one hundred to two hundred feet or so, all round the adjacent coasts, and up the Bristol Channel.

"Indiscriminately mixed with these remains, were found some smaller flint chips, and bolt or arrow-heads.

"On the question then of the antiquity of man upon our earth, our caves here at Tenby give as yet no testimony, because though works of art have been found mixed with these bones of huge animals, the cave-earth has been so disturbed, that their original position cannot be ascertained."

The Intellectual Observer. No. 1. February. London: Groombridge and Sons, 1862.

'Recreative Science,' the first of the popular serials on popular science, emanated from these publishers, and attained a large circulation. Somewhat too juvenile in character, it could not have been expected long to maintain a stand against such higher flights as Mr. Hardwicke's 'Popular Science Review.' The 'Intellectual Observer' is 'Recreative Science' sprung into manhood, and a vigorous forcible manhood too, ready and able to compete with any rival.

We have a decided horror of popular (?) science—or rather that kind of trash which unfortunately goes by that name. We believe that *real* science *is* popular, is a household god whose presence is universally felt in this land, though its face is less often recognized than it might be. In the curtains that screen the light from our rooms, the carpets we tread on, the paper that lines our walls, in our coals, our furniture, in every object around us down to the handles of our doors and the pulleys of our window-blinds, the teachings of real science lie hid, although their effects add unceasingly to the pleasures of life. The able writer—editor, we presume too, although his name does not appear as such upon the work—Mr. Shirley Hibbert, opens the volume with a survey of last year's work. Messrs. McGawley, Cobbold, Thos. Wright, Couch, Gosse, Slack, Humphreys, and Webb follow with excellent papers: a staff of good quality for popular science work, and able to it well if they work sincerely, as they ought to do.

The Year-Book of Facts in Science and Art. By John Timbs, F.S.A. London: Lockwood & Co., 1862.

A small book of 288 small pages in very small type, full of information gleaned from at least double that number of sources, some of which are acknowledged; some—the best sometimes—not so. Some critics have found fault with Mr. Timbs for putting in extracts just as he took them. We do not. At least it is honest, when the title of the work is given: it is useful, because we can go to the source itself for more information if we want it, which is better than wasting one's time in wondering where we have read the matter before, as we do after perusing hundreds of the modern short cooked-up notices of other people's labours so generally in vogue. We would add the wish rather that the *date* of the publication should be also given. Mr. Timbs, at any rate, knows good from bad—which is more than most compilers do—and so, if his book be a book of selections, we can recommend it as having very much that is useful in it.

Memoirs of the Geological Survey. Geology of parts of Oxfordshire and Berkshire. (Sheet 13.) By Edward Hull and W. Whitaker.
Geology of parts of Berkshire and Hampshire. (Sheet 12.) By H. W. Bristow and W. Whitaker. London: Longman and Co., 1862.

The numerous splendid geological maps and sections which the Government Surveyors have already produced, show the perseverance and energy of that small but talented staff, and testifies to the ability with which they are directed. But there are many other ways, besides in the execution of their regular duties, that the Survey officers are benefiting the students of our science. The museum in Jermyn Street is being admirably arranged by Mr. Etheredge on a plan at once effective and novel,—that of marking, by placing them on differently coloured tablets, the characteristic fossils of each stratum. The collection is, as our readers well know, arranged on a stratigraphical plan; and by the use of coloured tablets, in walking past cases we see at a glance the fossils we ought to find in any ordinary locality of every geological formation. To the student this is a facility of the highest value, and enables him, whether studying for a class or preparing for a full excursion, to learn with certainty and ease the essentially typical fossils of every stratigraphical group or of the district he is visiting.

Not a less happy idea was it to illustrate or rather to explain the map-sheets of the Survey, by short memoirs of the geology of the districts they represent. Thus, the fluvio-marine beds of the Isle of Wight have been described by Edward Forbes; the country round Cheltenham, by Mr. Hull; parts of Wiltshire and Gloucestershire, by Professor Ramsay; the South Staffordshire Coal-field, by Mr. Jukes; the Warwickshire Coal-field, by Mr. Howell; the country round Woodstock, the country round Prescot, in Lancashire, parts of Oxfordshire and Berkshire, and the Wigan Coal-field, by Mr. Hull; part of Leicestershire, and parts of Northamptonshire and Warwickshire, by Mr. Aveline. The West Indian surveyors have followed this excellent example, and we have had a memoir on the geology of Trinidad, by Messrs. Wall and Sawkins.

Two others just issued are before us, 'The Geology of Parts of Oxfordshire and Berkshire (Sheet 13),' by Messrs. Hull and Whitaker; and 'The Geology of Parts of Berkshire and Hampshire (Sheet 12),' by Messrs. Bristow and Whitaker.

The Geologists' Association are about to take again their summer excursions: how admirably instructive it would be to take one of those geological spots in Berkshire or Hampshire, which Mr. Bristow so faithfully and accurately describes in this little eightpenny Memoir; and with the geological map of the district, Mr. Bristow's descriptions of the sections and other exposures of the strata, of their order, sequence, and mineral characters, and Mr. Etheredge's lists of fossils, how much more instruction would be got out of some of those pleasant holidays than can ever be attainable under the best desultory leadership!

In Mr. Hull's 'Oxfordshire' a small coloured geological map is inserted, reduced by photography from the larger Ordnance sheet, so that we have in it map and text for a week's good geological labour. In Mr. Bristow's Memoir, the cretaceous rocks and tertiaries from the Eocene of Woolwich and Reading to the alluvium of the Kennet, is treated in a masterly manner, and illustrated by well selected woodcuts. The cretaceous deposits and tertiaries, as also the oolitic series, form the topics of Mr. Hull's 'Memoir on Oxfordshire and Berkshire,' and, we need scarcely say, are treated in an equally able manner.

THE GEOLOGIST.

APRIL 1862.

SPONTANEOUS GENERATION.

It would be obviously inappropriate to discuss in the pages of the 'Geologist' the theories propounded in Dr. Pouchet's celebrated work,* with respect to the heterogenetic production of beings of simple organization from inorganic particles; but as the learned author has devoted the whole of his sixth chapter, comprising sixty-seven octavo pages, to the discussion of the "geological proofs" on which he has based his theory, we cannot avoid offering to our readers a slight sketch of the arguments M. Pouchet so eloquently propounds.

His theory is thus stated:—At various epochs, of which no chronology can offer an idea, inert matter has been formed into organized beings, without the aid of any pre-existent organism. This, he says, is a natural consequence of geology, which none will dispute. He further deduces that there has been, subsequent to this first act of creation, other generations, and that perhaps at the present day new species are being called into existence. If a Supreme Being, who manifests His unity over every portion of the globe, has eternally and universally presided over all the phenomena which take place on its surface; and if it has been His pleasure to people the earth with tribes of plants and animals which have succeeded on it, why may He not be repeating at the present day that which He has already done during past times? As P. Gorini has said, spontaneous generation

* 'Hétérogénie, ou Traité des Générations spontanées, basé sur l'expérimentation; par le docteur Felix A. Pouchet.' 8vo. Paris.

is not a more marvellous phenomenon than ordinary reproduction; and M. Pouchet cannot conceive why it is regarded as such an extraordinary act. Nature is not abandoned to the disorder of chance; she is governed by harmonious laws, and each act which is accomplished in her depths is connected with the past and is lost in the future: each generation which appears is only the corollary of that which has preceded it (p. 461).

He goes on confidently to affirm that "the theory of the formation of the earth is not at present the subject of any doubt on the part of geologists. It is evident that our planet has been originally an incandescent mass, surrounded with an immense atmosphere of gas and vapour; and that, in cooling, it has endured all the physical or chemical conditions which necessarily resulted from its change of state."

His argument goes on to say, that certain parts of the globe having been upheaved at different periods, each has separately originated a fauna peculiar to itself, the degree of perfection of which is in the ratio of the antiquity of the continent supporting it. Thus, the inferiority of the Australian men arises, according to M. Pouchet, from the Australian continent having been upheaved later than the other parts of the world, and the men consequently being more modern, have not yet reached their summit of development, like the old races of Europe and Asia. The same argument applies to the marsupials of Australia, who are, so to speak, the embryo forms of the placental mammalia of the Old and New Worlds. This theory is almost the reverse of that adopted by many geologists, who speak of Australia as being a "belated" portion of the earth's surface, isolated from the rest of the world at an early period, and bearing the emblems of a bygone Fauna of *Cestracions* and *Trigoniæ*, analogous to those of the old Oolitic period.

Our readers will have seen that it is rather as a Biologist than as a Geologist that M. Pouchet has a chance of securing disciples in England. Turning however to his researches on the means of production of animals from inorganic matter (*heterogenesis*), his facts and arguments seem insurmountable. We confess ourselves unable to detect any flaw in the chain of testimony which he brings forward, and regret that the nature of this periodical precludes us from offering some of his experiments in detail. All the objections which were made by previous writers have been disposed of by M. Pouchet. The animals produced belong to the lowest forms of *Aerita*, and the flaws in the experiments of Schultze and Crosse have been carefully obviated.

We are anxious to remove the supposition that there is anything like absurdity in the physiological argument, however there may be in the geological deductions of our author. The facts recounted by him are only those which a pains-taking observer would collect, and the work is (for a Frenchman's) singularly devoid of any imaginative flights.

Hasty Biologists condemn the theories of M. Pouchet, without giving due weight to his arguments. Such writers will never range in the list of advocates of spontaneous generation, amongst whom M. Pouchet triumphantly quotes "Anaxagoras, Leucippus, Democritus, Epicurus, Aristotle, Pliny, Lucretius, Diodorus Siculus, Kircher, Rondelet, Aldrovandus, Matthioli, Fabri, Bonanni, Burnet, Gassendi, Morison, Dillen, Buffon, Guéneau de Montbéliard, Needham, Priestley, Ingenhousz, Gleichen, Stenon, Baker, Wrisberg, Fay, Werner, O. F. Müller, Braum, Rudolphi, Bremser, Goeze, Nees von Esenbeck, Eschricht, Unger, Allen Thomson, De Lamétherie, Cabanis, Lavoisier, Lamarck, Saint-Amans, Turpin Desmoulins, Latreille, Bory St. Vincent, Dumas, Dugès, Eudes-Deslongchamps, Gros, Tiedemann, Treviranus, Bauer, J. Müller, Burdach, Carus, Oken, Valentin, Dujardin, and A. Richard."

Pouchet remarks that the antagonists of spontaneous generation have always treated its partisans with a severity with which a just cause is never defended; they have often represented the theories of spontaneous generation as the mere fruits of insanity; nevertheless, the illustrious names who avow their belief in it merit a greater respect, and the opinions of men who have so much honoured science should be carefully examined before they receive so disdainful a reprobation (p. 5).

Chevreul has remarked that truth for all right-minded men, whatever their position in life, is the most precious of all objects: for sooner or later it will triumph over error. Descartes wished to examine all scientific theories, even the most unlikely and the most false, "to the end," he said, "that he should know their just value and guard against being deceived." The same favour M. Pouchet implores; and he demands, as a right, that his work shall not be judged until after it has been read and considered. Professor Owen has told us, "If it be ever permitted to man to penetrate the mystery which enshrouds the origin of organic force in the wide-spread mud-beds of fresh and salt waters, it will be, most probably, by experiment and observation on the atoms which manifest the simplest conditions of life. . . . Whether an independent, free-moving, and assimilating organism, of the grade of structure of a germ-cell, may not arise by a collocation of particles through the operation of a force analogous to that which originally formed the germ-cell in the ovarian stroma, is a question worthy all care and pains in its solution. Pouchet has contributed valuable evidence of such production, under external influences, of species of Protozoa. With regard to the species of higher organisms, distinguishable as plants and animals, their origin is as yet only matter of speculation."—Palæontology, 2nd ed., pp. 18 and 441.

In these liberal and advanced sentiments, we must cordially concur. We recommend our readers to examine M. Pouchet's work carefully, and, if possible, to test his experiments over again. English minds too often exhibit an excessive reluctance to truths which on the Continent have been generally accepted. Trusting that this work may receive "a fair field and no favour," we conclude our remarks, with the hope that many more volumes of equal scientific importance may proceed from the gifted pen of the Director of the Museum of Natural History at Rouen.

FURTHER NOTES ON THE GENUS *CAINOTHERIUM.*

By Charles Carter Blake, Esq.

The genus *Cainotherium* was founded by Bravard in the year 1835. Since his time it has received the following names:—*Cyclognathus*, Geoffroy St. Hilaire, 1835; *Microtherium*, Herm. von Meyer, 1837; *Oplotherium* and *Plectognathus*, Laizet and De Parieu, 1838; whilst the characteristically synthetic mind of De Blainville reunited it to the genus *Anoplotherium*, under the title of *latecurvatum*.

Gervais* says it is probable that many species, and not one only, can be recognized amongst the remains which have been discovered, and that this conclusion has been admitted by all palæontologists who have studied these small pachyderms.

Pomel† urges strongly the necessity of distinguishing many species among the *Cainotheria*, properly so called. He excludes from this genus the *C. Courtoisii*, which he erects into a type apart (*Hyægulus*). Gervais, on the contrary, gives merely to the genus *Cainotherium* a subgeneric value, subordinating it to *Dichobune* in his system. M. Pomel does not give any certain characters by which his five species can be distinguished. I translate his characters, such as they are:—

* 'Zoologie et Paléontol. Françaises,' 4to, Paris, 1859, 2nd edition, p. 92.

† Comptes Rendus de l'Académie des Sciences, Paris, t. xxxiii. p. 7.

C. laticurvatum: head large, especially towards the frontals, with a straight profile as far as under the orbits, depressed towards the fronto-parietal surface.

C. commune (= *C. latecurvatum*, De Blainville): smaller; head more lengthened, and more elevated towards the parietal region.

C. elegans: of the size of the preceding: head still more convex towards the fronto-parietal suture: palatines more sloping: limbs more slender.

C. metapium (? *metopium*, from μετώπιον, forehead): size of the preceding; head more concave in front of the orbits; forehead consequently more elevated; zygomatic arch very short.

C. gracile: one-third smaller; mandibular bone very narrow, symphysis shorter, more projecting beneath; limb-bones very short.

I have recently made a careful examination of the *Cainotheria* in the British Museum, where M. Bravard's and M. Pomel's specimens are deposited, with a view to detect any specific differences which might be visible. I have not had the opportunity of knowing on which specimens M. Pomel's conclusions were founded. I merely record my conviction that the British Museum collection does not contain more than two species at most, the *Cainotherium commune* and *C. metapium*, if the specific distinction of the latter species is to be admitted. Some of the specimens in the British Museum collection are named *C. majus* by M. Pomel. Another, apparently not specifically distinct from the *C. commune*, M. Bravard terms *C. leptheliciium*. One of the Museum specimens, by the degree of concavity or depression of the preorbital space, may belong to the *C. metapium* of Pomel, but this is very doubtful. No dental distinction has been detected by me, even though aided by a strong lens. The few slight differences which otherwise exist are merely referable to age. The degree of backward inflection of the coronoid process of the jaw varies, so to a less extent do the proportions of the limb-bones, but not more so than between the skulls of musk-deer at various ages.

The generic name *Microtherium* must clearly give place to *Cainotherium*, which was invented two years earlier. Of the identity of the species there can be no doubt. The specimen of *Microtherium Renggeri* in the British Museum, from the Miocene of Haslach, in Wurtemberg, being the right upper maxillary, with *m* 3 coming into place, is in no manner specifically distinct from the *Cainotheria* from Allier, in the same case.

Whether the genus *Hyægulus* of Pomel rests upon a correct appreciation of its generic value, may be much doubted. The mere fact of the scaphoid and cuboid bones being confluent would scarcely merit generic distinction, and the alleged deeper sculpturing of the hinder molars in *Hyægulus murinus* is far from visible on M. Gervais' plate. The teeth of *Cainotherium Courtoisii* might very well belong to the young of *Cainotherium commune*, before the molars have been abraded by use. The abrasion of the molars in some of the Museum specimens might lead a hasty species-maker to form several species.

None but the practical worker can appreciate the difficulty of identifying the lower jaws with the forms to which they belong. No specific dissimilarity in size or position of the teeth meeting each other has been noticed by me. None of the limb-bones can be identified to belong to the same individuals as the crania or lower jaws.

I give the characters of the genus from Gervais, and the synonyms according to my own views :—

CAINOTHERIUM, *Bravard.*

"Teeth in continuous series; certainly $\frac{7}{7}$ molars [= premolars $\frac{4-4}{4-4}$, molars $\frac{3-3}{3-3}$], four toes, of which the two median digits are the largest, and similar to each other; the two last very slender."—Gervais, *loc. cit.*

1. CAINOTHERIUM COMMUNE, Brav. memoir on *Cainotherium* = following species :—*C. laticurvatum*, Pomel, *loc. cit.* *C. elegans*, Pomel, *l. c.* *C. gracile*, Pomel, *l. c.* *C. leptorhynchum*, Pomel, 'Bulletin de la Société Géologique de France,' 1846, t. iii. p. 369. *C. medium*, Brav., *l. c.* *C. minimum*, Brav., *l. c.* * ? *Hyægulus collotarsus*, Pomel, *l. c.* * ? *Hyægulus murinus*, Pomel, *l. c.* = *C. Courtoisii*, Gervais. *Oplotherium laticurvatum*, Laizet and De Parieu. *Oplotherium leptognathum*, Laizet and De Parieu. *Microtherium Renggeri*, H. v. Meyer. *Microtherium concinnum*, H. v. Meyer. *Cainotherium majus*, Pomel, MS. ? *Cainotherium lepthelicium*, Bravard, MS. ?

2. CAINOTHERIUM METOPIUM, Pomel, *l. c.* A very doubtful species. In British Museum ?

The problem of specific creation and extinction can be best worked out upon such genera as *Cainotherium.* Speculation might lead a Natural-Selectionist to imagine how the four-toed *Cainotheria* of the Miocene, by reason of their firmer footing in a muddy soil, might have been able to go deeper in a river in quest of food, and have supplanted and caused the extinction of the *Dichobunes* of the Eocene, who had only one small digit at the back of their foot, making three toes in all. The differences between, *e.g. Cainotherium*, *Dichobune*, *Xiphodon*, and *Dichodon*, and *Aphelotherium*, are such as we might suppose might be altered through the lapse of long generations. Whether such alteration was slow and gradual by Natural Selection or any similar process, or whether it was not rather due to a more rapid and sudden method of operation, is the problem which the latter half of the nineteenth century may perhaps solve by experiment, observation, or logical demonstration. In the meanwhile, to those who bear in mind the Linnæan maxim, *Omnis vera cognitio cognitione specifica innitatur*,† the study of the minute differences of the *Cainotheria* affords an instructive topic.

* I have not seen any authentic specimens of these species. The *C. Courtoisii* of Gervais appears not to be specifically distinct from some specimens of *C. commune*

† Linné, 'Species Plantarum,' 8vo, Vindobonæ, 1764, p. 3.

SECTION OF THE LIAS CLAY IN A RAILWAY-CUTTING NEAR STOW-ON-THE WOLD.

By the Rev. S. Lucas, F.G.S.

As Mr. E. Hull of the Geological Survey, in his 'Geology of the Country around Cheltenham' (1857), p. 24, complains of the scarcity of sections of the Upper Lias in that district, and as a section in the Railway, near Oddington and Stow-on-the-Wold, exhibits a section of Liassic clays, which appear to me to belong to the upper series, I beg to offer you the following rough but accurate account of the bed there exposed.

The list of fossils has been made with the assistance of a geological friend in London.

I believe the section here described is not at the very top of the Lias, for on the hill-side on either side of the valley the Lias ascends considerably higher than at the railway-cutting. The cutting, which is in the parish of Mangersbury, is about twenty-five to thirty feet deep, and the section is as follows :—

1. Clay	6 feet	. There are no fossils in this bed. It has been probably mostly washed down from higher ground.
2. Ferruginous Bed .	1 ft. 6 in.	This is almost one compact mass of shells : *Belemnites elongatus*, Mill.; *Ammonites hybrida*, D'Orb.; *A. Humphreysianus* (young), Sow.; *A. Henleyi* (young), Sow.; *A. annulatus* (young), Sow.; *Nautilus*; *Trochus imbricatus*, Sow.; *T. cyclostoma* (?), Quenst.; *Pleurotomaria anglica*, Sow. (including *P. Amalthei*, Quenst.); *P. Pallium*, Sow.; *Helicina* (*Rotella*) *expansa*, Sow.: *Turbo euomphalus*, Quenst.; *Astarte; Unicardium cardioides*, Phil.; *Pholadomya Murchisoniæ*, Sow.; *Cucullæa Muensteri* (?), Quenst.; *Arca Muensteri*, Quenst.; *A. elongata*, Quenst.; *Myacites Liassinus*, Quenst.; *M. elegans*, Phil.; *M. tumidus* (?), Mor. and Lyc.; *M.* sp.; *Myoconcha psilonoti* (?), Quenst.; *Cardium multicostatum* (?), Quenst.; *Modiola Scalprum*, Soc.; *Anomia; Gryphæa incurva*, Sow.; *G. obliquata*, Goldf.; *Ostrea; Plicatula spinosa* (and var.), Sow.; *Avicula inæquivalvis*, Sow.; *Perna* (*Crenatula*) *ventricosa*, Sow.; *Pecten sublævis*, Sow.; *Plagiostoma Hermanni*, Goldf.; *P. duplicatum*, Sow.; *Rhynchonella rimosa*, Sow.
3. Stiff Blue Clay .	3 feet	. Containing an Ammonite (*A. Henleyi*), and only a few other fossils.
4. Hard, slightly more ferruginous and impervious bed.	. 1 foot	. A small *Unicardium* (*U. verrucosum*), is very plentiful in this bed, generally occurring as single valves.

5. Stiff Blue Clay	5 feet	With *Ammonites Henleyi*, *Perna ventricosa*, and *Myacites*.
6. Hard stiff Blue Clay	12–14ft.	With *Ammonites fimbriatus*, *A. margaritatus*, *A. Henleyi*, *Perna ventricosa*, and small Pentacrinite.
7. An irregular band of limestone, generally formed of a mass of shells	. . . .	*Unicardium cardioides*, *Cardinea concinna*, *Myacites tumidus* (?), *Modiola scalprum*, *Gervillia lævis*, *Perna ventricosa*, *Lima* (small), *Ostrea* (small), *Pecten sublævis*, *Plagiostoma Hermanni*, *Terebratula numismalis*, *Rhynchonella furcillata*, *R. concinna*, *R. subconcinna*, *Pentacrinus*.

The upper shelly bed (No. 2) undulates; the distance between the crest and the trough of the wave being about a hundred yards, and the depth of the trough about six feet. This is very much stained with oxide of iron.

The clayey beds Nos. 3, 5, 6, have fossiliferous concretionary nodules, and are all very similar; they contain but few fossils, and those mostly of the same species. Bed No. 7 is also stained with iron, but not so much so as bed No. 2. It is very irregular as to its composition; the stony bed being often interrupted by coarse concretionary masses at some distance from each other. This bed I also found at Oddington, four miles from the railway-cutting; and there it is only just beneath the surface-soil, so that there must have been considerable denudation.

I should think that the Upper Lias Clay is much thicker in this locality and at Chipping-Norton than is generally supposed. Mr. Bliss, the owner of the factory there, told me that he bored 500 feet without getting through the clay. This is where it crops from beneath the Inferior Oolite.

Though the beds above described may possibly belong to the Middle Lias, yet I think there is much evidence to the contrary, such as the close contiguity of the Inferior Oolite, especially the "passage-sands," with the ferruginous ammonite-bed. At Oddington, about three miles from the cutting, these sands rest directly on bed No. 7 of the section.

TRAILS, TRACKS, AND SURFACE-MARKINGS.

By T. Rupert Jones, F.G.S.

Geologizing, with some friends, on the south coast of the Isle of Wight, a few summers since (1859), we noticed some puddles of rain-water in the clay talus of the Wealden Cliffs near Brook Point, and observed that, like other such surfaces, the partially dried clay beds of the diminished pools showed rain-prints, foot-tracks, trails, and the rings of broken bubbles. Amongst these various markings are *convex* trail-like lines (fig. 1), which at first appeared difficult to account for; but, recollecting Mr. A. Hancock's remarks on the so-called Annelide tracks, published in the 'Annals of Natural History,' 3rd series, vol. ii. p. 443, plates 14–19, I looked carefully on the wetter parts of the clay, along the edges of the puddles, and soon saw little beetle-like insects boring into the clay, and apparently traversing such galleries, just beneath the surface, as the little narrow convex sinuous markings may be due to. One of these insects I enclosed alive in its clay habitat, but I could not afterwards find it, when I had the specimen of surface-marked clay at home. The cut edges of the pieces of clay show the openings of the numerous little galleries (fig. 1 *b*). Some of them are close to the surface; some are an eighth of an inch or more below: in the latter case, probably the roof of the gallery received coatings of mud after it was raised up, retaining its convexity.

Fig. 1.—A piece of the dried clay bed of a pond in the Isle of Wight, showing the convex roofs of small galleries made by burrowing water-insects. 1 *b*, a portion of the cut edge, showing a section of some of the galleries. (Nat. size.)

At some spots the roofs of the galleries were the only markings of the surfaces; at other places the concave trails were most abundant. The origin of these was obscure; for the pools were too temporary to be the home of molluscs or crustaceans; insects or worms, therefore, may have caused them. The Rev. Mr. Hislop showed me, not long since, a specimen of hard reddish shale (possibly of Triassic age) from Korhadi, Central India, on which one of the many superficial long, narrow, hollow trails stopped short with what certainly appeared to be an *insect*, coated with muddy matter, and entangled, as it were, in the clay whilst ploughing its little furrow.

In fig. 2, we have some faint rain-prints at one corner (*a*),—numerous small bubble-rings over a large portion of the surface,—several deep, long, concave trails all over the specimen,—three or four faint convex gallery-marks, and some footprints of birds. The latest bird-track shows three footprints, deeply marked on the bubbly surface, probably a slightly depressed area remaining moist after the other

Fig. 2.—Another piece of dried clay, from the same pond, showing a long trail at *a*; and other trails, *h*, *k*; a bird's footprints (*c*) treading in an old trail at *b*, *b*; a new gallery being formed at *e* subsequently to the bird's impressions on the soft mud; *f*, old footprint of another bird under new gallery; *g*, orifice; *d*, bubble-marks; *i*, *i*, *i*, rain-prints. (Nat. size.)

part had become nearly dry.* In advance of these is a more faintly

* This minutely-spotted surface reminds one of that portion of the woodcut in plate 7, in vol. ii. of the 'Geologist,' which is said to be "pitted with worm-holes in the sheltered hollows."

marked footprint, and that it was of earlier date is shown by one of the gallery-marks passing athwart one of its toe-prints, whilst the other end of the gallery has been trodden in by the last foot-mark of the first-mentioned track.

Specimens of sandstone showing the casts of similar convex and concave trails are common in some of the Wealden beds * and other thin-bedded rocks formed in shallow water; but the modifications are extremely numerous, and will require much careful observation before they are elucidated. Accurate drawings, at least, should be taken of trails and other surface-markings made by aquatic animals. Mr. A. Hancock's published sketches (above referred to) of the gallery-tracks of minute crustaceans (*Sulcator arenarius* and *Kroeyera arenaria*) that bore the sand of the sea-shore, are good examples of what is required of those who would assist the geologist to decipher the obscure tracks and trails (too often termed annelid-marks) by the light of nature.

Mr. Poulett-Scrope, Mr. Strickland, Dr. Buckland, and Mr. Salter have published the results of some careful comparisons of recent and fossil tracks and trails; but have not figured the recent markings on which their conclusions rest. See Geol. Proceed., vol. i. p. 317; iv. pp. 16, 204; Quart. Jour. Geol. Soc., vol. x. p. 208; xii. p. 246; xiii. p. 199, etc. In these instances, Fishes, Crustaceans, Molluscs, and Worms have been quoted as the probable agents.

In his 'Report on the Agriculture of New York' ('Natural History of New York,' Part V.), vol. i. (1846), p. 68, etc., plates 14, 15, 16, Professor E. Emmons describes and figures several so-called Lower Palæozoic "annelid-tracks," such as he has since referred to the trails of larval insects.

Some sagacious remarks on fossil trail-prints are made in Mr. James Hall's 'Palæontology of New York,' 1852, vol. ii. p. 26, etc.; and numerous figures of such and other surface-markings from the Silurian rocks of the State of New York are given in the plates 11 to 16 of that volume.† Indeed, of the so-called Fucoids illustrated by plates 1, 2, 3, 5, 5ᵃ, 6, 7, 8, 9, and 10 of that volume, there are some that have been referred by Mr. Salter to the work of Annelides. Mr. Hall says—"As a fact in proof of the similarity of the trails of other animals to these supposed remains of Annelida, I may mention that the *Nemapodia tenuissima* of Emmons has been proved to be the trail of some existing animal over the outer surface of the rock, removing the minute lichen which covers it, and discolouring the rock beneath."—J. Hall, Palæont. New York, vol. ii. p. 32, *note*.

An instance in which recent tracks have been figured in illustration

* On the under-surface of a rippled sandstone shale from Stammerham, near Horsham, I have observed numerous small, thread-like cylinders of sandstone, forming an irregular reticulation, which must have been due to the fine sand, when moist, having entered horizontal galleries in a clay or mud beneath: after having hardened, the sand, on the removal of the clay, has remained in the form of delicate free cylindrical casts, attached by their ends to the under-surface of the slab.

† Notes by the late Prof. E. Forbes, on some of these figures, are appended by Mr. J. Hall, at page 37.

of fossil tracks with some good results, is to be found in Prof. Emmons's 'American Geology,' part vi., 1857, chap. xvi., p. 135, etc. Referring to the fossil tracks found so abundantly in the sandstone of the Connecticut Valley, he says :—" In the progress of discovery other imprints have come to light, differing in every respect from the preceding. Those in the first instance were regarded as fossil Nereites, Myrianthes, etc., or Annelids, whose surfaces, or exterior, possessed a sufficient consistency to form an imprint upon a yielding surface. Most of these markings, however, are now referred to foot- or body-marks of Crustacea or Mollusca, which have been made in a manner similar to the trails of certain shell-fish, as they move over a soft bottom. Such trails are preserved upon the rocks; but in addition to these, there are many others which must be due to water-insects, or their larvæ. We may easily convince ourselves of the possibility of the preservation of footprints, or the trails of the bodies of larvæ, by the inspection of a pool of water which has stood a few days after a shower of rain. These pools, while drying, will leave frequently a smooth, glossy surface of indurated clay or mud, which will be marked by innumerable tortuous lines of different patterns, according to the character of the body and feet possessed by the animal which has travelled over this smooth impressible surface.

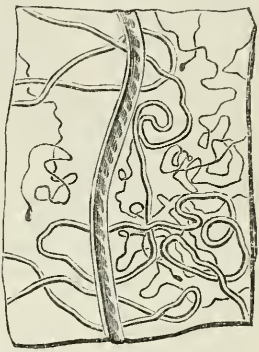


Fig. 3 (105, Emmons).

"As these recent trails are instructive as well as useful in explaining ancient phenomena of a similar kind, I propose to illustrate their characters by the annexed figures of some of the more common form of trails which may be seen by the margins of drying pools of water during the summer season. Fig. 105 (fig. 3) is a copy of the imprints made by the larvæ of two different species of dipterous insects. It is, however, only of the larger that I can speak with certainty; for I have found in this trail, or by it, the dead larva. The darker spots which terminate the finer trail mark the places where the larva entered the mud. Frequently the larger trail terminates in a hole in the mud also. Fig. 106 (fig. 4) is copied from another pattern, having lateral fringes. This resembles very closely the imprints which have been referred to Nereites. Upon this surface, also, the impressions of rain-drops are perfectly preserved.

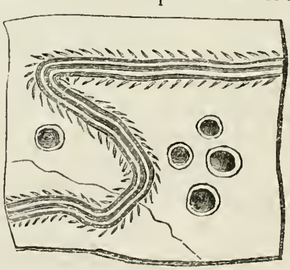


Fig. 4 (106, Emmons).

"An equally interesting kind of trail is exhibited in the margin (fig. 107), which was probably made by a water-insect, or one having legs (fig. 5). The first (fig. 105) were made by

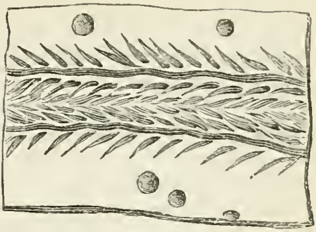


Fig. 5 (107, Emmons).

an apodous larva. This imprint (fig. 107) was made upon an impressible surface, but sufficiently indurated to preserve the form and character of the trail. This trail, however, is gradually changed into one having the form exhibited in fig. 108 (fig. 6). This fact is important, and should be remembered. The change in this instance is due to the change in the consistence of the mud itself. In the last figure it is copied from that part of the trail which was made when the water still stood over it, and when it was so liquid as to flow and fill up, in part, the imprint. The two patterns are so different that, if they were apart, they would very naturally be attributed to two quite different animals.

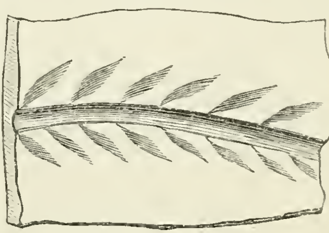


Fig. 6 (108, Emmons).

"Imprints upon the Taconic slates in Maine and New York do not differ materially from the foregoing. So, also, those upon shales belonging to the Ontario division, near Utica, which I was the first to point out, and which are figured in Mr. Hall's second volume of Palæontology,* appear to have been made by water-insects; at least, they do not differ very much, in character and form, from many which we may find in drying pools after our summer showers.

"Fig. 108 is not very unlike a figure which I gave several years ago in my 'Report of the Geology of New York,' and which were made upon the green slates belonging to the Taconic system in Maine, and slates, too, which are among the oldest sediments in the world.

"If the foregoing remarks and observations are true, it proves that the soft fragile larvæ of insects existed in the earliest periods, or at the time when the oldest sediments were deposited."

Going on to speak of the fossil tracks and trails in the Connecticut sandstones at Turner's Falls, Professor Emmons expresses a belief that the tracked surfaces formed a border around and outside the main body of the sediment, and were due to the overflow of rivers and ponds after heavy rain-falls. "This view of the subject," he says, "is sustained by what takes place in every great freshet in the rivers of the Southern States. Here the large rivers and their tributaries, such as the Oronoko, Dan, and Cape Fear, overflow their banks, and spread over the meadows or low ground, upon which a sediment two or three inches thick is thrown down. The river, on subsiding, leaves the deposit to dry gradually; and, in the meantime, it will be tracked by insects, worms, frogs, lizards, rats, and birds, all of which will

* 'Palæont. New York State,' vol. ii. pl. 13, fig. 2: similar to those figured in Emmons's 'Agricult. New York,' vol. i. pl. 15, fig. 3, and pl. 16, fig. 3.

leave their peculiar imprints. While the mud is drying, it separates and produces what are termed sun-cracks, which are always present in the layer which has preserved foot-marks in the sandstones of the Connecticut Valley."

That the footprints and rain-marks of the Connecticut sandstone might have been made on the banks of a river or estuary, Sir C. Lyell has shown in his 'Travels in North America,' vol. i. p. 254, and vol. ii. p. 168; 'Principles of Geology,' 9th edit., p. 203; 'Anniv. Address to the Geol. Society, 1851;' 'Manual of Geology,' 5th edit., pp. 348, 384; and 'Notices of the Royal Institution,' vol. i. p. 57. Dr. James Deane* (who first drew the attention of naturalists to these fossils) and Prof. Hitchcock,† in America, have explained and illustrated these vestigial phenomena with great labour and skill.

In Britain we have a plentiful supply of equally obscure phenomena in the *Arenicolites*, *Scolites*, *Helminthites*, and *Vermiculites* of the Silurian, Carboniferous, and other rocks, and in the foot-tracks in the Millstone-grit of Tintwistle, in the Coal-measures of Dalkeith and the Forest of Deane, in the Permian sandstones of Corncockle Muir, Dumfriesshire, and other places, in the New Red Sandstone of Annandale, in the New Red deposits of Cheshire and Warwickshire, in manifold markings on the Forest-marble, and in the great trifid footmarks and other prints in the Wealden of Sussex. That these great trifid footprints, the casts of which were found by Mr. E. Taggart‡ and Mr. Beckles,§ and carefully described by the latter, should prove to have been made by the three-toed Iguanodon is not unlikely,

Fig. 7.

* 'Boston Journ. Natural History Soc.,' vol. v. p. 282. 'Mem. Americ. Acad. Arts and Sc.,' new series, vol. iv. p. 209 (9 plates). 'Journ. Acad. Nat. Scienc., Philadelphia,' 2nd series, vol. ii. p. 71; vol. iii. p. 173. 'Silliman's Journal,' vol. xlv. p. 178; vol. xlvi. p. 73; xlvii. p. 292; xlviii. p. 158; xlix. p. 213; new series, vol. iii. p. 75; v. p. 40. 'Ichnographs from the Sandstone of Connecticut River,' 1861, Boston (46 plates.)

† 'Memoirs American Academy,' new series, vol. iii. p. 129. 'Boston Journ. Nat. Hist. Soc.,' vol. vi. p. 111. 'Elementary Geology,' new edit., 1860, p. 181. 'Report on the Geology of Massachusetts,' p. 477, etc. 'Geology of the Globe,' p. 98. 'Silliman's Journal,' vol. i. p. 105; vi. pp. 1, 201; vii. p. 1; xxix. p. 307; xxxi. p. 174; xxxii. p. 174; xlvii. p. 292; 2nd series, iv. p. 46.

‡ Journ. Geol. Soc., vol. ii. p. 267.

§ Quart. Journ. Geol. Soc., vol. vii. p. 117; viii. p. 396; and x. p. 456, pl. 19.

Portion of the Underside of a

SANDSTONE SLAB from the UPPER HASTINGS SAND

At Bigg's Farm, near Cuckfield.

[In the Collection of T. Rupert Jones, F.G.S.]

S. J. Mackie, F.G.S., del.

though they may have been due to birds. I may mention, that a friend in India (Mr. R. N. Mantell, since deceased) described to me in a letter, some large, broad, trifid markings that he saw on the sand-banks of the Ganges; they were of this shape (fig. 7), shallow, and with a well-definededge. Tracing the track to where the sand was wet, he found them take the unmistakeable and unpretending shape of ordinary bird-tracks (fig. 8); "the sole and sufficient reason," said he, "of their gross exaggeration was the action of the wind on the fine dry sand." Trying prints of his own hand, he saw them slowly become augmented into broad caricatures of a hand-print by the same natural process.

Fig. 8.

On the figured slab of Wealden rock, from the Upper Hastings Series, near Cuckfield, Sussex (Pl. VII.), we have sun-cracks, raised gallery-markings, and many obscure trails, some corrugated, some smooth. It is possible that, as a friend has suggested to me, some of these may be the marks of roots of aquatic plants; but there is no direct evidence on the subject. Root-like markings, however, small, vertical, and numerous, occur abundantly in the Hastings sand-rock, as pointed out to me by my friend Mr. J. Morris (see fig. 9).

During the autumn of the same year as that in which I collected the recent trail-marked mud in the Isle of Wight, I was in the Weald of Kent, and, examining a brick-field, I saw a pond lessened by drought, and on its mud were prints of a dog's feet, small hollow trails, and convex galleries, such as those before noticed (fig. 10). The roofs of some of these last were so thin they were split, and in some cases removed. Besides the markings above mentioned, the drying clay had another interesting feature, namely, a partial coating of minute globular bodies (fig. 10 *a*), mostly lying closely packed in single layer, but sometimes crowded irregularly, and occasionally scattered about loosely. These are of the same colour as the clay, and are probably the ova of the Boat-fly (*Notonecta*), thinly coated with clay; and their interest lies in the fact that in Mexico allied insects are known to lay a profusion of large ova in the Lake of Tezcuco, and that there they become petrified into an *oolite*. The fact has been described by M. Virlet d'Aoust, in the 'Bulletin de la Soc. Géol. de France,' 2e Sér., vol. xv. p. 200, etc., 1858, who, noticing the oolitic structure of the recent limestone on the margin of the salt-water lake of Tezcuco, near Mexico,* learnt from Mr. J. C. Bowring, the manager of the salt-works there, that the oolitic granules were nothing more than the eggs of certain insects, encrusted and cemented together by the calcareous sediment of the lake. The eggs, too, being attached by little stalks or pedicels, are the more readily coated with the lime all over, and keep their relative position the more firmly.

* See the memoir for some interesting information on the relationships of the great freshwater and salt lakes of the Mexican plateau; also, E. B. Tylor's 'Anahuac,' 1859.

These ova are deposited, according to M. Guérin-Méneville, by Hemipterous (Notonectid) insects; the most abundant being the *Corixa femorata;* the other (which lays the larger eggs) being the *Notonecta unifasciata.* They are said to fly about the water in myriads, and occasionally plunge below the surface to the depth of several feet, there depositing the eggs. The Indians collect the eggs, by placing bundles of reeds in the water, which in twelve or fifteen days get covered with millions of ova; these they dry for an hour or two, and remove from the rushes, and sell as an article of food.*

M. Virlet d'Aoust remarks that probably an analogous origin of oolite has existed in all geological epochs; and he points out some of the conditions of certain oolites that favour this view,—indeed, he seems to think that nearly, if not quite, all oolites, calcareous and ferruginous, have been formed in this way.†

The oolitic travertine of Tezcuco is also described by Mr. E. B. Tylor, in the interesting narrative of his travels in Mexico, entitled 'Anahuac; or, Mexico and the Mexicans, Ancient and Modern,' 1859, already reviewed in the 'Geologist.' At page 156, he says:—

"When I look through my notes about Tezcuco, I do not find much more to mention, except that a favourite dish here consists of flies' eggs fried. These eggs are deposited at the edge of the lake, and the Indians fish them out and sell them in the market-place. So large is the quantity of these eggs, that at a spot where a little stream deposits carbonate of lime, a peculiar kind of travertine is forming, which consists of masses of them imbedded in the calcareous deposit. The flies which produce these eggs are called by the Mexicans 'axayacatl,' or 'water-face.' There was a celebrated Aztec king who was called Axayacatl; and his name is indicated in the picture-writings by a drawing of a man's face covered

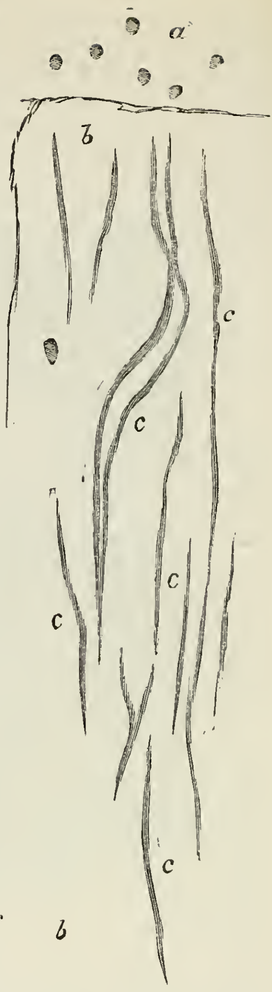


Fig. 9.—Piece of white Hastings Sand, from the East Cliff, Hastings, showing long linear vertical holes (*b*, *c*), in section; *a* surface. (Nat. size.)

* M. Virlet d'Aoust gives much interesting information about this substance (termed Haoutl), in the culinary and antiquarian points of view. See also a notice by M. Guérin-Méneville, translated in the 'Annals of Nat. Hist.,' ser. 3, vol. ii. p. 313.

† See also, 'Geologist,' Vol. II. p. 73.

with water. The eggs themselves are sold in cakes in the market, pounded and cooked, and also in lumps *au naturel*, forming a sub-

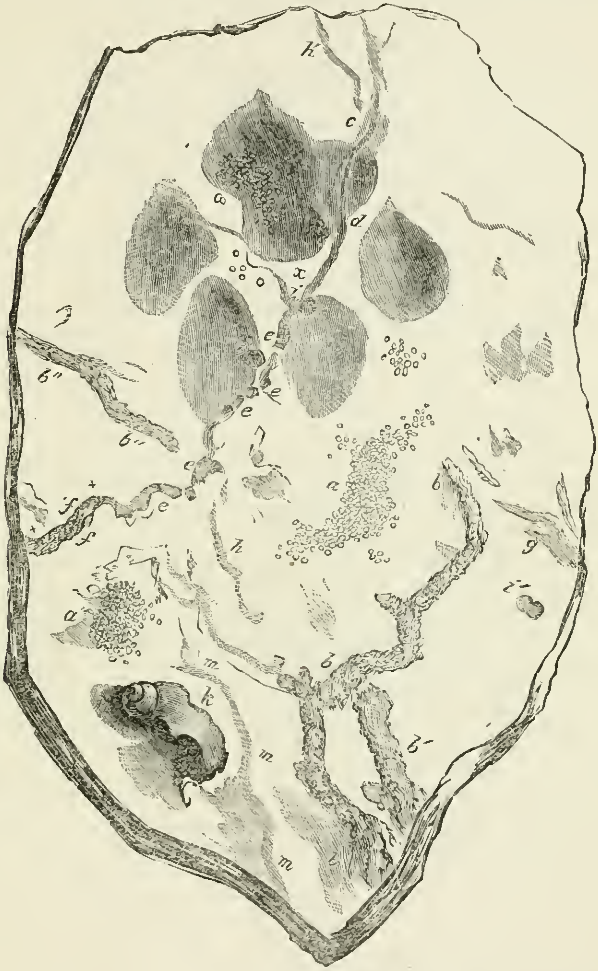


Fig. 10.—A piece of the dried clay bed of a pond in Kent. *a*, *a*, ova of boat-flies (?); *b*, *b′*, *b″*, galleries, with raised roofs, made by water-insects; *c*, *c*, furrow, made by a water-insect, crossing the footprint (*x*) at *d*; at *e* the furrow enters a gallery, of which the roof has been broken; at *f* it becomes a tunnel or gallery, with convex roof, such as seen also at *b*, *b*; *g*, *g*, small galleries; *h*, *h*, furrows; *i*, *i*, holes; *k*, *k*, shell of a *Limnæus*; *m*, *m*, a furrow-track.

stance like the roe of a fish. This is known by the characteristic name of 'ahuauhtl,' that is, 'water-wheat.'"

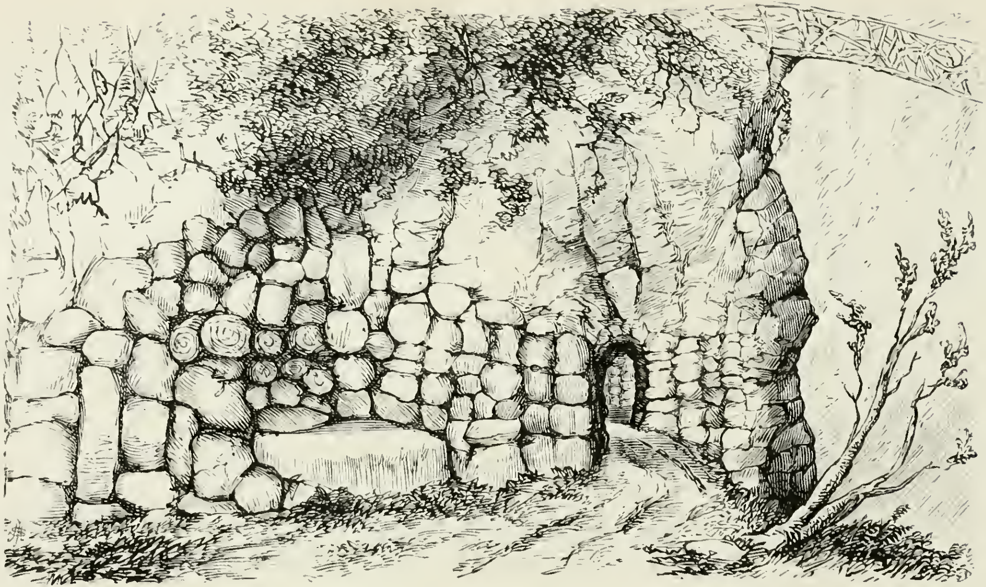
The occurrence of the eggs of insects in the Mexican travertine, to which they add a by no means inconsiderable bulk, certainly support, to some extent, M. Virlet d'Aoust's hypothesis of the origin of organically formed oolite by means of ova, if not always due to *insects'* eggs; and the entanglement of similar eggs in the clay of ponds also shows how insects may have exercised an agency, however slight, in the formation of some other stratified deposits. If to these evidences of insectal agencies, we add the probable fact, that the surfaces of many shales of various geological ages bear the trails of insects, as intimated above, pages 129 and 131, we have stronger proofs than we had heretofore of the wide-spread and long-continued existence of Insects in past ages of the world.

To get better and clearer notions, we want more carefully observed and recorded facts than we have hitherto had at command. Let us get good observations on the crawling and burrowing creatures of the sea-shore and pool-sides, of sand- and mud-banks, and alluvial flats; let us get good dried specimens or good drawings for comparison; and let us carefully collect and collate fossil surface-markings, noting what are real surfaces and what are casts on the lower sides of the laminæ and strata, and we shall then be doing good work towards the elucidation of *Ichnolites* of all descriptions.

Before concluding, I must offer an observation on the *Climactichnites Wilsonii*, Logan,—a gigantic trail-like tract found in the Potsdam Sandstone of Canada, and described and figured by Sir W. E. Logan, in the 'Canadian Naturalist and Geologist,' 1860, vol. v. p. 279, etc. In this paper, Sir William lucidly describes the probably littoral condition of the Potsdam Sandstone, extending for many miles along the old Laurentine Hills, and its evidences of tidal phenomena. The *Climactichnites* is associated at Perth, in Canada, with the *Protichnites*, tracks found also in other parts of the Potsdam Sandstone of Canada, and described by Logan and Owen in 1852, in the Geological Society's Journal, vol. xiii. p. 199, etc., plates 6–14*a*. Of the Canadian *Protichnites*, there are six different kinds or species, according to Prof. Owen; they are all of large size, from about three to ten inches broad, and are referred to Crustaceans, possibly of the Limuloid type, that have crawled over the surface of the sand.* *Protichnites* of smaller size have been found in the Silurian rocks of Scotland, at Binks, Roxburghshire, by Prof. R. Harkness ('Quart. Journ. Geol. Soc.,' vol. xii. p. 243, fig. 2); and another, from the Coal-measures of South Wales, has been figured and described by Mr. Salter, in the 'Memoirs of the Geol. Survey, etc.: Iron-ores of South Wales,' 1861, p. 227, pl. 2, fig. 24.

The *Climactichnites* is described as a trail about 6¾ inches broad; and it is not dissimilar, in its transverse bars, to fig. 1*c* of Mr. A. Hancock's plate (XIV., see above, p. 131), illustrative of the natural gallery-track of the little sea-shore crustacean, *Sulcator arenarius*. I would suggest that the Climactichnital tracks were really infallen gallery-tracks, formed, like those of the *Sulcator*, by *burrowing* Crus-

* Simple narrow concave trails, also, are not wanting in the Potsdam Sandstone of Beauharnois, Canada.



THE "CHEESE GROTTO" OF THE EIFEL.

[From a Sketch by J. E. Lee, F.G.S., of Caerleon.]

S. J. Mackie, F.G.S., del.

taceans, possibly some of the same animals as those that left the Protichnital trail-markings on the surfaces of the sandstone.

The *Climactichnites* is also analogous, in respect to its transverse bars, to the *Crassopodia Embletonii*, Tate ('Geologist,' vol. ii. p. 66, pl. 2, fig. 2; and 'Berwickshire Nat. Field-club Transact.,' vol. iv. p. 104, pl. 1, fig. 2), which, according to Mr. A. Hancock's views (*loc. cit.*, p. 456), would be an infallen gallery, probably made by a Trilobite belonging either to the genus *Phillipsia* or *Griffithides*.

Trilobites, and those of large size, are present in some of the older palæozoic rocks of North America, not far from the geological horizon of the Potsdam Sandstone; and, although they do not appear to have been preserved in this littoral sandstone, yet there is the possibility of their having frequented the shallow waters of that old sea, just as the Trilobites of the Carboniferous period probably furrowed the Lower Carboniferous sands without being preserved therein. If, however, *Limuloid* animals made the trails above mentioned, we must remember that, according to Mr. W. H. Baily,* the so-called "Limuli" of the Coal-period, or more properly the *Bellinuri*, are more closely allied to the Trilobite than to the *Limulus*, having well-defined thoracic segments; and therefore probably *true Limuli* had nothing to do with the production of any of the Protichnital trails. Trilobital, Bellinural, Amphipodal and other Crustaceans, with sea-worms and molluscs, may have made most of the trails, runs, or tracks that we have to do with in the Palæozoic rocks, and even insects may have aided in some instances, as intimated by Mr. Emmons,—but we want much more information in nearly all cases. Nor are we better off as regards our knowledge of similar markings in the Secondary and Tertiary strata. It is hoped that the foregoing notes may suggest further research in the right direction.

THE CHEESE-GROTTO OF BERTRICH-BADEN, IN THE EIFEL.

The mountainous district known as the Eifel, or Eifel-Gebirge, in Rhenish-Prussia, is, as all geologists know, famous for the numerous well-preserved craters of extinct volcanos and for the lava-streams, scoriæ, trachyte, and basalt connected therewith.

The English reader will find a short account of the tertiary and volcanic rocks of the Eifel in Lyell's 'Manual of Geology,' chapter xxxi.; and a good geological map of the Eifel and neighbouring districts is appended to a paper, by Sedgwick and Murchison, on the Rhenish Provinces, in the Transactions of the Geological Society, 2nd series, vol. vi. part 2. In the Eifel there are two extensive areas, in which volcanic activity has been especially intense. One of

* Journal Geol. Soc. Dublin, vol. viii. p. 89; and 'Explanation of Sheet 137, Geol. Surv. Map Ireland,' p. 13, figs. 3 and 4.

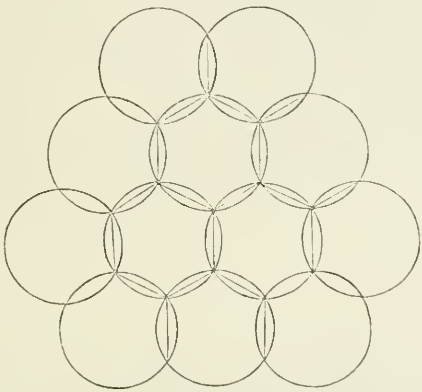
these of irregular outline is crossed by the Rhine at Andernach. Its western and more important part is about three miles long and two broad. The Laacher See is well known as a lake occupying an old crater in this part of the country, not far from Andernach. This district was described and illustrated by Dr. S. Hibbert, in 1853, in his 'History of the Extinct Volcanos of the Basin of Neuwied,' etc. The other district, characterized by volcanic rocks and craters dispersed over an area of about four miles by three, is at a short distance to the south-west, and contains several large lake-craters, such as the Gemunder Maar, the Pulver Maar, the Meerfelder Maar, etc. One of the old lava-streams in this area is met with at Bertrich, on the Ees, a small river running into the Moselle half-way between Treves and Coblentz. Consisting of columnar basalt, and being perforated by a natural aperture, this mass of volcanic rock presents the aspect of a basaltic colonnade, and has always attracted the attention of travellers, especially as the joints of the basalt, instead of taking a regular polygonal or angular shape, are more or less spheroidal, "so that a pillar is made up of a pile of balls, usually flattened;"* hence the grotto at Bertrich is called the Käsegrotte, or Cheese-cave. "The basalt is part of a lava-stream, from thirty to forty feet thick, which has proceeded from one of several volcanic craters still extant on the neighbouring hills;"† and, having run in the valley, it has since been partially destroyed and excavated by long-continued water-action. Mr. J. E. Lee has favoured us with a pencil sketch of this interesting Cheese-grotto, from which Plate VIII. has been engraved; and, although the grotto is well known to geological students by the woodcut in Sir C. Lyell's 'Manual,' p. 386, yet we think that as the subglobular character of the basalt is very much better shown by our correspondent's sketch than in the little woodcut alluded to, we shall be doing good service by producing it here.

In connection with the Cheese-grotto, Sir Charles alludes to the occurrence and characters of globular lavas and trap-rocks, adducing particularly the globiform pitchstone of Chiaja di Luna, described and figured by Mr. Poulett Scrope, in his account of the Ponza Isles (Geol. Trans., 2nd ser. vol. ii.). This pitchstone has the globiform structure near its junction with prismatic trachyte; and itself shows a tendency to the columnar division; the columns, however, separating into large globes or ellipsoids, placed one upon another, and, when weathered, readily desquamating at a touch into numerous concentric coats, having a kind of onion-peel structure. Different degrees of the prismatic or columnar condition, passing into the concentric and nodular, are observable in many basaltic and trachytic lavas, as well as in older trap-rocks (diorites, etc.); and indeed granite not unfrequently shows a tendency to split and exfoliate in a similar manner.

The explanation of the columnar and nuclear structure is well given on Mr. P. Scrope's 'Considerations on Volcanos,' etc., 1825 (an admirable work, now out of print, but about to be revived, we hope). In chapter 6, p. 134, etc., the divisionary structure assumed

* Lyell's Manual Geol. p. 387. † Ibid.

by lava in its consolidation is fully discussed. In a lava when cooling there are centres of attraction more or less affecting all the crystalline particles; and in a uniform mass cooling throughout alike, these centres would be equidistant and the contractile force equal. "In this case all the spheres of attraction would be equally similar in size and form, and would arrange themselves as closely as possible, that is, in the manner of the cells in a honeycomb, or as the circles in the figure below.



"The fissures of retreat produced by the contractile force of all the spheres, acting contemporaneously, must evidently therefore divide the consolidated layer into hexagons, each straight fissure being tangential to the opposite spheres of attraction between which it is formed."

CORRESPONDENCE.

On the Composition of a peculiar Substance from the Wallabies' Holes, River Murray.

SIR,—In a recent number of 'The Geologist' (February, 1862) appeared the description and a sketch of a Tertiary limestone on the River Murray, in Australia. In this limestone are a series of holes or warrens, inhabited by hosts of wallabies, kangaroo-rats, etc., and from these cavities there exudes a peculiar dark brown, sticky, odoriferous matter, in considerable quantities. This substance has been handed to me by Mr. Rupert Jones, F.G.S., for chemical examination. The result of my analysis is as follows:—

Bitumen and petroleum, with débris of mosses	40·57
Sand and white mica	22·49
Phosphate of alumina, with a little oxide of iron and phosphate of lime	6·42
Carbonate of lime	30·52
	100 00

No uric acid, nor any other organic matter besides those named, is present. When treated with soda a slight trace of ammonia is evolved, which comes probably from the remains of mosses. The latter, whose weight may amount to about 4 or 5 per cent. of the whole, are in so perfect a state of preservation that the teeth of the seed-caps and indentations of the leaves, as well as the internal tissue of the same, are most distinctly seen under the microscope.

The bitumen belongs to the species known to mineralogists as *Malthe*. It dissolves in alcohol and in caustic soda, but is insoluble in water. When the whole mass is submitted to heat it swells and gives out much smoke, which has rather an agreeable odour. It is impregnated with a small quantity of petroleum, which causes it to stain paper like oil.

The mineral matter, which amounts to nearly 60 per cent., is cemented together by the bitumen.

It will be seen by what precedes that this peculiar substance is made up of natural hydrocarbons, which have cemented together a certain amount of mineral matter. It has nothing to do with the animals which infest the warrens, except perhaps that by boring into the rock they have given it a means of exit.

Yours, etc.,

T. L. Phipson.

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

Geological Society of London.—*February* 21.—Annual General Meeting.—Sir R. I. Murchison, V.P.G.S., in the chair. The Secretary read the Reports of the Council, of the Museum and Library Committee, and of the Auditors. The Society was shown to be in a satisfactory state, as to finances and the number of Fellows. The Wollaston Gold Medal was awarded to Mr. Robert A. C. Godwin-Austen, F.R.S., F.G.S., for his long-continued and valuable researches in Geology, particularly into the ancient geographical and hydrographical conditions of the Western European area in the Palæozoic, Mesozoic, and Cænozoic periods; and also for his acute and judicious elaboration of the theory of the presence of Carboniferous rocks at a moderate depth beneath the south-east of England. The Wollaston Donation-fund was given to Professor Oswald Heer, of Zurich, in recognition of his valuable labours in the elucidation of the Fossil Plants and Insects of the Tertiary strata of Switzerland and Croatia, and especially of the Fossil Flora of Bovey-Tracey, in Devonshire.

The Chairman next, having read a letter from the President, regretting his unavoidable absence in Italy, expressed his sense of the great services rendered to the Society since its foundation by Mr. Leonard Horner. He then proceeded to read an obituary notice of the late Dr. Fitton. Mr. W. W. Smyth, secretary, read obituary notices of the late Rev. J. S. Henslow, Mr. J. MacAdam, Mr. Eaton Hodgkinson, Sir C. Fellows, Prof. Necker, and others. Finally, Prof. Huxley, secretary, read an Address, the principal objects of which were—to urge upon Geologists and Palæontologists the necessity of reconsidering the logical basis of several of their most generally accepted conceptions, such as the doctrine of Geological Contemporaneity, and the assumption that the fossiliferous rocks are coeval with the existence of life on the earth,—and to test the ordinary hypotheses of the progressive modification of living forms in time by positive evidence.

The Officers elected for the ensuing year are:—*President*: Prof. A. C. Ramsay. *Vice-Presidents*: Sir P. de M. G. Egerton; Sir Charles Lyell; John Carrick Moore, Esq.; Prof. John Morris. *Secretaries*: Prof. T. H. Huxley; Warington W. Smyth, Esq. *Foreign Secretary*: W. J. Hamilton, Esq. *Treasurer*: Joseph Prestwich, Esq. *Council*: John J. Bigsby, M.D.; Sir Charles Bunbury; Robert Chambers, Esq.; Sir P. de M. G. Egerton; Earl of Inniskillen; Hugh Falconer, M.D.; W. J. Hamilton, Esq.; Leonard Horner, Esq.; Prof. T. H. Huxley; John Lubbock, Esq.; Sir Charles Lyell; John Carrick Moore, Esq.; Edward Meryon, M.D.; Prof. John Morris; Sir R. I. Murchison; Robert W. Mylne, Esq.; Joseph Prestwich, Esq.; Prof. A. C. Ramsay; G. P. Scrope, Esq.; Warington W. Smyth, Esq.; Alfred Tylor, Esq.; Rev. Thomas Wiltshire; S. P. Woodward, Esq.

February 26, 1862.—Prof. Ramsay, President, in the chair.

Special General Meeting.—It was resolved that the annual contribution to be paid by both Resident and Non-Resident Fellows elected after the 1st of March next shall be two pounds two shillings per annum; the composition for future annual contributions being twenty-one pounds.

Ordinary Meeting.—The following communications were read:—

1. "On the Drift containing Arctic Shells in the neighbourhood of Wolverhampton." By the Rev. W. Lister, F.G.S. In the parish of Bushbury, at the junction of the London and North-Western, the West Midland, and the Stour-Valley Railways, is a gravel, with clay, sand, and pebbles, rolled Liassic fossils, flints, pieces of coal and of wood, and more or less fragmentary shells of the following species (as determined by J. G. Jeffreys, Esq., F.R.S., F.G.S.):—*Astarte arctica*, *Cardium echinatum*, *C. edule*, *Cyprina Islandica*, *Modiola modiolus*, *Tapes virginea*, *Tellina solidula*, *Venus striatula*, *Litorina squalida*, *Nassa reticulata*, *Purpura lapillus*, and *Turritella communis*. The *Astarte* and the *Litorina* are not now found living in our seas. Similar fossil shells have been also found by the author at Oxley Manor, half a mile to the N.W.; by Mr. G. E. Roberts at Acleton, eight miles to the S.W.; and by Mr. Beckett elsewhere. Liassic fossils have also been found in the gravel at Compton Holloway and at Wightwick (both in the parish of Tettenhall), and at Wolverhampton.

2. "On a Split Boulder in Little Cumbra, Western Isles." By James Smith, Esq., F.R.S., F.G.S. The islands of Great and Little Cumbra have (like the west coast of Scotland) a cliff and terrace, indicating an elevation of about 40 feet above the present level of the sea, and the removal of at least 100 feet of rock (sandstone and trap); the sea at its present level having worn away the rock to the extent of only a small fraction of an inch. The terrace on the Little Cumbra has been moreover ground down and scratched by ice-action, the striæ passing unobliterated under the present sea; and on the terrace lies a split boulder, such as are known to fall from glaciers, and which the author thinks must also in this case have fallen from an escarpment of ice.

3. "On the Ice-worn Rocks of Scotland." By T. F. Jamieson, F.G.S. The author, first referring to the eroded surface of the rocks beneath the Drift-beds in Scotland, proceeded to show that the action of ice, and not that of torrents, could produce such markings, as he had observed in the bed of a mountain-stream in Argyllshire, down which had poured the torrent caused by the bursting of the reservoirs of the Crinan Canal. He then advanced reasons for considering that the erosion of the rocks in Scotland was due chiefly to land-ice and not to water-borne ice, bringing forward remarkable instances of ice-action on the glens and on the hill-sides at Loch Treig and Glen Spean, where moraines, blocs perchés, striæ, roches

moutonnées, and boulders lifted above the parent-rocks indicate a northern direction for the great ice-stream from Loch Treig to the Spean, and then an eastern course on one hand up Loch Laggan, and a western, on the other, down the Spean. Up Glen Roy the ice had apparently passed north-eastwardly, over the watershed towards the Spey. In Knapdale, Argyllshire, similar evidence is obtained of a great ice-stream passing over hill and dale; here falling into the Sound of Jura. The author referred to Rink's and Sutherland's observations on the continental ice of Greenland as affording a probable solution of these phenomena; and, objecting to the hypothesis either of floating ice and of debacles being sufficient to account for the conditions observed, he thought that land-ice, moving from central plateaux downwards and outwards, has effected the extensive erosions referred to, both in Scotland and other northern regions, at a time when the land was at a much higher level than at present. This must have been followed by a deep submergence, to account for the stratified and shell-bearing drift-beds.

March 5.—" On the Glacial Origin of certain Lakes in Switzerland, Scotland, Sweden, and North America." By A. C. Ramsay, F.R.S., President of the Geological Society. The author first stated that in this memoir he proposed to extend his theory of the glacier-origin of the smaller mountain-lakes of Wales and Switzerland (published in 'The Old Glaciers of North Wales') to those greater lakes of Switzerland, which, like the tarns above alluded to, lie in true *rock-basins*. He then explained a map, compiled from those of Charpentier, Morlot, and Mortillet, showing the ancient extension of the great Alpine glaciers across the Lowlands of Switzerland to the Jura, also over the area that surrounds the Lake of Constance, and on the South into the plains of Piedmont and Lombardy. All the great lakes of Switzerland, and the lakes of Como, Lugano, and Maggiore, lie directly in the course of one or other of these great glaciers; and, as shown by the soundings, and the levels of the rocks at their mouths or in the river-beds below, each of these lakes, like the smaller tarns of the Todten Sea and the lake at the Grimsel, was shown to lie in a true rock-basin. He then considered the question of the denudation of the Alpine and Miocene areas of Switzerland, and showed that none of the lakes lie in *aboriginal undenuded synclinal hollows*. Next, that they do not lie in areas of mere watery erosion. Neither running water nor the still water of lakes can scoop large hollow basins like those of the lakes, bounded on all sides by rocks. Running water may fill them up, but cannot excavate them. He next contended that they do not lie in lines of gaping fracture. A glance shows this with respect to such lakes as those of Geneva, Neuchâtel, and Constance; and, reasoning on the nature of the contortion of the strata of the Alps, he contended that, though fractures of the rocks must be common, they need not be gaping fractures. To produce such a mountain-chain, the strata are not *upheaved and stretched* so as to produce open cracks; on the contrary they are *compressed laterally and crumpled up* into smaller space, and the uppermost strata, that pressed heavily on the crumpled rocks now visible, would prevent the formation of wide open fractures below, these upper strata, as in North Wales, having, over a great part of the area, been mostly or altogether removed by denudation. Next, lakes of the rock-basin kind do not lie each in an area of special subsidence. If so, for instance, we should require one for the Todten See, one for the Grimsel, one for the ancient lake of the Kirchet, several at the foot of the Siedelhorn, many hundreds close together in Sutherlandshire, and thousands in North America.

If then the lake-basins were formed by none of the above-named causes, the only other agent that has affected the country on a great scale is glacier ice. All the lakes lie directly in the courses of the ancient glaciers. The basin of the Lake of Geneva is 950 French feet deep near its eastern end, and was scooped out by the great glacier of the Rhone, the ice of which, from data supplied by Charpentier, was, as it issued from the valley, 3,550 feet thick to the bottom of the lake. This great weight of ice ground out the hollow of the lake, which gradually shallows towards Geneva, where the glacier thinned and the grinding power was lessened. Where the same glacier abutted on the Jura, the ice-current was arrested, and it flowed to the N.E. and S.W.; and where the ice was thickest and heaviest above the Lake of Neuchatel, it ground out the hollow in which the lake lies.

The lakes of Thun and Brienz lie in the course of the great Aar glacier, those of Zug and the Four Cantons in that of Altorf, the Lake of Zurich lies in that of the Linth, the Lake of Constance in the course of the prodigious glacier of the Rhine Valleys, the numerous little rock-basin lakes near Ivrea in the line of the glacier of the Val d'Aosta, and those of Maggiore, Lugano, and Como, in the courses of the two gigantic glacier-areas that drained the mountains between Monte Rosa and the Sondrio.

The sizes of the lakes and their depths were then shown to be, in several cases, proportional to the magnitude of the glaciers that ground out the basins in which they lie, and the circumstance as to whether the pressure of ice was broadly diffused, or vertical as in narrow valleys.

Finally, it was shown that rock-basins holding lakes are always exceedingly numerous in and characteristic of *all countries that have been extensively glaciated*. Lakes are comparatively few in the southern half of North America, but immediately south and north of the great lakes and the St. Lawrence, the whole country is *moutonnée* and striated, and is also covered with a prodigious number of rock-basins holding water. The same is the case in the North of Scotland, the whole area of which has been *moulded by ice;* and east of the Scandinavian chain, in another intensely glaciated region, the country is covered by innumerable lakes.

FOREIGN INTELLIGENCE.

M. Melleville, the Vice-President of the Société Académique of Laon, has published an account in the 'Revue Archéologique' of an object of human workmanship found in the lignites of that neighbourhood.

Starting on the basis that man was contemporaneous with the great carnivora and herbivora, and that objects of his workmanship are found with their bones, he goes on to make out that the beds containing them differ from the diluvium as much in the materials of which they are formed as in the fossils they contain, and that they are more ancient than it as they are everywhere covered by it. Those deposits belong to that geological age, which immediately preceded the present era; whilst it is admitted that the diluvium marks the commencement of the recent or historic period. The ultimate consequence he deduces from the published observations on this subject is, that there are *two stone-ages*—the first ante-historic, corresponding to the epoch of the formation of the lacustrine beds of the Somme, and characterized by large implements entirely of flints chipped but never ground; the other by far more finished and various products, indicating a more advanced art and established relations between the different tribes which at that period inhabited France. These premises he merely puts forward, reserving for a future occasion the discussion which alone can establish their correctness. What he desires to do now is to show that the field of discovery as to the antiquity of the human race is at least open, and that this question, already so wide from the little we as yet know, seems likely to be spread still wider by such discoveries as that of which he gives the details.

An object "incontestably fashioned by the hand of man" has been found at a depth of 75 mètres from the soil, in a perfectly virgin bed of the lignites or "cendres noires" at Laon, the geological age of which goes back, as is known, to the earliest times of the Paris basin deposits. Not but that objects of modern production have been found in these very beds, and he cites particularly a flint "hache," which was found fourteen years since at 25 feet under ground, in the middle even of the lignites quarried near the village of Lille, canton of Fère, department of Aisne. But these facts, besides being so rare, are capable, in general, of being explained by accidental causes of entombment, the lignites of the Laonnois and of the Soissonois lying ordinarily at the surface or only being covered by foreign deposits of no great thickness. This is not the case with the ash-bed of Montaigu, near Laon, whence the object in question comes. "The exceptional conditions of the bedding where it was found is precisely that which gives to this discovery a special interest, and perhaps a considerable value; and it is thus necessary to give here a slightly detailed description, and to make known the method of quarrying."

"The lignites worked for agricultural purposes near the village of Montaigu, four leagues north-east of Laon, occupy the foot of a Tertiary hill, constituted at its base of clays, amongst which these lignites are intercalated; in the middle, of thick masses of sand, enclosing some beds of shells; and at the summit by newer clays superposed on thick beds of hard rock—the *Calcaire grossier* of geologists, which form the crown of the hill. The 'ash-bed' is quarried by means of subterranean galleries, which extend in different directions under the hill—the principal one being driven into the centre of it for a considerable distance, its extremity not being less than 600 mètres from the point where it opens on the valley. This bed is about 2·30 mètres thick, and is covered by another bed of marly and sandy clay, full of fossil shells peculiar to that age—*Cyrena cuneiformis*, *Ostrea bellovacina*, etc., and which serves for the roof or ceiling of the quarry. This roof is sustained by means of wooden shores placed under and across as the gallery extends; the head only of the gallery being left free for the work of extraction. The 'ash-bed,' attacked at the foot, falls down into the space called the 'chamber,' detaching itself cleanly from the roof alluded to; and then the 'ashes' are put into small waggons running on an iron tramway. These 'waggons' in their turn are pushed by men out of the quarry, and the 'ash' is discharged and made into a heap for burning before being sold for agriculture. In the month of August last year (1861) the workmen employed at the end of the principal gallery, in throwing down a block of 'ashes,' observed with surprise an object detach itself and roll to some distance. Struck with this incident, such as had never before happened to them, they hastened to search for it, and found a ball of moderate dimensions. But their astonishment was increased when on examining it they thought they recognized it as the work of man's hand. They looked then to see exactly what place in strata it had occupied, and they are able to state that it did not come from the interior of the 'ash,' but that it was imbedded at its point of contact with the roof of the quarry, where it had left its impression indented.

Better judging than many other workmen who daily make similar discoveries without informing any one of them, these of Montaigu at once carried the object found to Dr. Lejeune, the proprietor of the 'ash' quarry, whose house was close by. It could not have fallen into better hands. At the first glance M. Lejeune saw that the ball was really of human workmanship, and he in his turn hastened to inform me of the circumstances of the discovery, no similar occurrence to which, as I have said, has happened within the memory of the workmen. However, long before this discovery, the workmen of the quarry had told me they had many times found pieces of wood changed into stone (the wood which is found in the lignites is nearly always, as we know, transformed into silex) bearing the marks of human work. I regret greatly now not having asked to see these, but I did not hitherto believe in the possibility of such a fact.

"I ought to add that no suspicion of deception can be entertained. The workmen who found the ball had never heard of M. Boucher de Perthes and his discoveries, nor of the high questions of archæology to which the presence of worked-flints deep in the earth have given rise. The ball of the 'ash-bed' of Montaigu carries also upon itself the mark of its own antiquity. It is easy to assure ourselves, on examining it with attention, that if it be permissible still to doubt whether its embedment dates back to the time when the bed was formed in which it was enclosed, it cannot be denied that its burial is ancient, and goes back to a period greatly remote from our own. The diameter of the ball is 6 centimetres, and it weighs 310 grammes, or about 10 ounces. It is of white chalk, and in this respect is distinguished from the stone-shot made use of for the artillery of the fifteenth and sixteenth centuries. These are constantly of sandstone or other hard and heavy rock. I have never seen one in chalk. Its form is imperfectly spherical, and its fracture unequal; it seems to have been fashioned with an instrument more blunt than cutting, from which one would suppose that the maker had only coarse and ineffectual tools. Three great splinters with sharp angles, announce also that it had remained during the working attached to the block of stone out of which it was made, and that it had been separated only after it was finished, by a blow, to which this kind of fracture is due.

"The workmen declare, as I have said, that the ball before falling to the ground was placed between the 'ash-bed' and the shell-bed which covered it. Its examination confirms in every way this assertion. It is really penetrated over four-fifths of its height by a black bituminous colour, that merges towards the top into a yellow circle, and which is evidently due to the contact of the lignite in which it had been for so long a time plunged. The upper part, which was in contact with the shell-bed, on the contrary has preserved its natural colour—the dull white of the chalk.

"I may add, that this last part gives with acids a lively effervescence, characteristic of carbonates of lime, whilst the rest of the surface which is impregnated with the bituminous matter alluded to, remains nearly insensible to the action of these acids. As to the rock in which it was found, I can affirm that it is perfectly virgin, and presents no trace whatever of any ancient exploitation. The roof of the quarry was equally intact in this place, and one could see there neither fissure nor any other cavity by which we might suppose this ball could have dropped down from above through all the series of beds which separate it from the surface of the plain.

"From what we have said, it remains then at least certain, that an object, a ball of chalk, fashioned by the hands of man, has been found in the stratum of 'black ashes' of the Laonnois, at a depth so considerable under the soil and under conditions of bedding such that it is impossible to comprehend how and by what means it could have been introduced in recent times. I am certainly amongst those who think that science has not yet said its last word about it. But from one fact, even so well established, I do not pretend to draw the extreme conclusion that man was contemporary with the lignites of the Paris basin. . . . My sole object in writing this notice is to make known a discovery as curious as strange, whatever may be its bearing, without pretending to any mode of explanation. I content myself with giving it to science, and I shall wait before forming an opinion in this respect, for further discoveries to furnish me with the means of appreciating the value of this at Montaigu."—MELLEVILLE, Vice-President of the Academic Society of Lahon.

Such is M. Melleville's account, and we consider his resolution wise in hesitating to date back the age of man to the lower tertiary period of the Paris basin without further confirmatory evidence.

M. Omboni, in his paper on the Ancient Glaciers and "terrain erratique" of Lombardy, lately published by the Milan Society,* has given numerous details of the different valleys which debouche in Lombardy between the Lake of Orta and Brescia and of the glacial deposits they contain. All these have been visited by him, and he has particularly examined with great care the traces left by the glaciers of their lower limits. He indicates clearly where the enormous masses of ice, after having been long encased in the valleys of the southern flanks of the Alps, spread out and melted in the plain, leaving in front of them their terminal moraines. His principal conclusions are, that, during the Pliocene age, the valley of the Po formed part of the Pliocene Sea when the marine fossiliferous rocks of Varese, Nese, San-Colombo, and Casteneddo were deposited.

With the slow and gradual dislocation by which the Alps and the Apennines took their present forms, the valley of the Po became a great shallow gulf, when the most ancient of the quaternary rocks were formed, constituting the passage-beds from the Pliocene, and enclosing the bones of large quadrupeds. Then followed the commencement of the formation and the extension of the glaciers of the Alps in consequence of a cold and damp climate. This was the *first part* of the quaternary glacial epoch.

Next, the glaciers occupied all the valleys of the Alps and the basins of the lakes as far as the points where they now are, Sesto-Calende, Porto, Mendrisio, Como, Lecco, Iseo, etc. Great torrents dispersed the materials brought by the glaciers and formed the "ancient alluvium," which by degrees advanced the land and diminished the extent of the gulf. The stones brought by the glaciers lose their polish, their groovings and striæ become rounded and form part of the alluvium, while the large blocks are also rounded by the action of water. This was the *second part* of the glacial epoch.

The glaciers now extend still further, denuding the upper part of the alluvium and leaving on its lower part their terminal moraines, where we still find them. The production of alluvium still went on extending the land. This was the *third part* of the glacial epoch.

Then a change takes place—the climate becomes less cold The glaciers diminish and slowly arrive at their present limits, and during this period of retreat form concentric moraines nearer the high Alps. The torrents wear away the moraines which they encounter and transport the material to various distances, forming the most superficial portion, called "recent

* Atti della Soc. Nat. in Milano, 1861, t. iii., with a map of the ancient extension of the glaciers.

alluvium." The glaciers still occupied for a long time the deepest valleys, and prevented their being filled with alluvial deposits; then they melted, and the Lakes Maggiore, Como, and Lecco, Orta and Iseo were formed. This was the *fourth and last part* of the glacial epoch, which gradually merged into the present period.

NOTES AND QUERIES.

Conversion of Chalk into Marble.—Gustav Rose has been making new experiments on the deportment of carbonate of lime at high temperatures, both with and without fluxes ;* and, from their results, he has arrived at the conclusion that rhombohedral carbonate of lime is never a direct product.

According to the experiments of Sir James Hall, made in 1804, this has been directly produced when chalk and compact limestone were exposed to a high temperature under great pressure.

Hall's experiment has therefore been repeated by MM. Rose and Siemans. A gun-barrel was charged with dry elutriated chalk, rammed into a compact mass, and the gun-barrel then hermetically sealed at both ends, and exposed to the heat of one of M. Siemans' gas-furnaces. During the experiment the gun-barrel sprung, and in the crack there appeared a faint blue flame, evidently of carbonic oxide. The gun-barrel was then removed from the furnace, and on opening it the chalk was found converted into a light bluish-white coherent mass, slightly lustrous on the fracture, and with cracks running through the whole. The surface was covered with a snow-white, earthy, well-defined crust, and the cracks were lined with white earthy particles; these, as well as the crust, were composed of caustic lime. The compact mass, however, proved, on examination, to be unchanged in chemical properties; and in physical properties, though seemingly changed, when examined under the microscope, it showed the same small globules, and identically the same properties, as the unignited amorphous chalk. Although somewhat more coherent, the chalk was not materially altered, and in nowise converted into crystalline calcite. Another experiment was made with fragments of rhombohedral calc-spar, but was also interrupted by the rupture of the gun-barrel.

M. Rose considers, from these experiments, that chalk or compact limestone cannot be converted into crystalline limestone or calc-spar by exposure to a high temperature in closed vessels; and, as a general fact, that rhombohedral carbonate of lime is not formed in the dry way. He also observes that, on comparing accurately the description of Hall's experiments and Bucholz's observations incidentally made in the production of caustic lime from chalk, probably they obtained results similar to his own, and that the slightly coherent, but otherwise unaltered mass, was erroneously considered to be crystalline marble. But what is most singular is, that notwithstanding Hall's experiment has been quoted and use made of it, not only in explaining geological phenomena, but in serving as the foundation of theories, it was *never repeated* or confirmed; and the experiments of M. Rose show it at least to have been hasty, although we do not think M. Rose's have been as complete nor as *long continued* as

* For an account of Herr Rose's experiments, see Transactions of the Berlin Academy; Poggendorf, Annalen, c. xi. 156; and Silliman's Journal, xxxii. 112.

they ought to have been. It is not to be disputed that at the junction with granite and basalt, compact limestone and chalk are often converted into marble, as in Paradies-backen, near Drammen, in Norway, and near Belfast, in Ireland; but, in the case of granite, the *dry* method of conversion cannot be any longer tenable, since the experiments of Sorby, Delesse, and others, have altered our conviction of its origin. Such changes, then, cannot be regarded as due to heat alone, and that they were assisted by other agencies is a conclusion arrived at also by Bischof in a different manner.

In the Anniversary Address to the Geological Society, the President, Mr. Leonard Horner, commented on these experiments in the following manner:—"With every respect for my friend the Professor, I think that I may turn round upon him and say that *he* has been somewhat hasty in considering that his experiments prove that mistakes were made by Hall in his descriptions of the results of his numerous experiments, all agreeing while obtained in so many different ways; for the Professor states that in both of his experiments the gun-barrel burst (at what stage of the experiment, he does not say) and thus one of the essential conditions in Hall's experiments was wanting, viz. continued great pressure. I consider therefore that these experiments of Professor Rose in no degree invalidate those of Hall, so long considered to support, in no inconsiderable degree, the hypothesis of Hutton."

Saurian Remains in the Lower Lias.—Some remains of Enaliosauria, recently found in the shales at the top of the Rhætic series, zone of *Ammonites planorbis* (Wright), exposed near Droitwich, are of more than ordinary interest. One, unfortunately much distorted, skeleton of *Ichthyosaurus intermedius* still holds, in the space between the ribs, the contents of the stomach, which, however, do not present any different features from the example described and figured by Dr. Buckland, being chiefly scales of *Pholidophorus leptocephalus* and some indeterminable fragments of Echinidæ, probably of *Cidaris Edwardsii*, the spines of which occur very abundantly in these shales. Jaws of *Ichthyosaurus tenuirostris* have also been met with in fine condition in this little-known locality. The specimens have been carefully collected, and are now in the cabinet of Richard Smith, Esq., of Westacre, near Droitwich.

Fish-remains in these Lower Liassic beds should be more attentively searched for. I have just received a letter from a noted microscopist, relating to the otolithic bone of *Pholidophorus*, which makes a fine object in the microscope.—George E. Roberts.

Origin of Species.—At the Zoological Society, on the 28th January, Professor Owen read a paper on the anatomy of the Aye-Aye (*Cheiromys Madagascariensis*). The only point of interest to geological and paleontological readers was the part of the paper in which Professor Owen entered into the evidence afforded by the peculiarities of this animal on the question of the origin of species; after showing the arguments in favour of the derivative hypothesis, and those against its mode of operation as propounded by Buffon, Lamarck, and Darwin, he came to the conclusion that, whilst the general evidence on this subject was in favour of creation by law, he was compelled to acknowledge ignorance as to the mode in which such secondary causes might have operated in the origin of Cheiromys. At the same time Professor Owen fully admitted that the attempts to dissipate the mystery which environed the origin of species, whether successful or not, could not but be fraught with great collateral advantages to zoological science.

REVIEWS.

Antiquarian, Ethnological, and other Researches, in New Granada, Equador, Peru, and Chile. By William Bollaert, F.R.G.S. London: Trübner and Co., 1860.

What has an antiquarian and ethnological book to do with geology? Something, we reply, if it contain any *geological* facts. And geological facts are spread about in antiquarian, and ethnological, and geographical, and many other sorts of books that appear to have no particular connection whatever with the science of rocks and fossil remains. There is an old adage referring to the futility of looking for a needle in a load of hay; and, although we should never attempt to search through the thousands of volumes of travels, descriptions of races, of idols, and of the dug-up relics of times gone by, for the few disseminated facts they contain, yet there is no reason why we should not adopt Captain Cuttle's famous principle of "when found make a note of," and record these accidental incidents as they fall in our way. So it is that in noticing Mr. Bollaert's book here, we shall offer an *olla podrida* of gleanings, rather than a systematic review. We shall pay less attention to the fair of Turmequé than to the emeralds which are brought there; we shall dwell less on the exhortations of Xue at Bosa than to the rib which the Spaniards found there venerated by the Indians, and believed to have been brought thither by that personage. In a foot-note about emeralds, we are told the green varieties are found at Muzo, north of Bogotá, and that tantalic acid and columbium occur in some varieties. Fine emeralds can be seen at Carthagena, extracted from the mines of Muzo by a French company. They are found in attached and imbedded crystals in alluvium, but the finest are from veins in a blue slate, of the age of our lower chalk, in the valley of Muzo. One statue of the Virgin in the Cathedral of Bogotá, besides 1358 diamonds and other precious stones, has 1205 emeralds. Not far from the mountain of Itoco, in the country of the Muzos, were found, in A.D. 1555, two emeralds weighing 24,000 castellanos.* Three leagues from Itoco is Abissi, where emeralds are found. In the East Indies, medicinal and talismanic virtues are ascribed to this gem. The Great Exhibition of 1851 contained the finest known emerald, two inches long, weighing 8 ozs. 18 dwts., which came from Muzo, and is supposed to have been brought to England by Don Pedro, who sold it to the Duke of Devonshire. We are not informed how the Chibchas worked emeralds and other hard stones; but the Mexicans, with tools made of copper and tin, fashioned emeralds into flowers, fish, etc. Cortez sent an emerald to Spain, the base of which was as broad as the palm of the hand.

But to return to the bone of Nemterequetaba or Xue, the ancient prophet of the Chibchas, who came from the East, wore a long beard, and had his hair tied in a fillet, for it brings us to another topic of some interest. Mr. Bollaert takes away all the romance of this religiously-preserved relic—the Goth! "It is probable," he hints, "this was the rib of a mastodon, for bones of that animal are found in the alluvium of Suacha, where teeth and other fossil remains are also met with. Holton says this place is famous for the bones of carnivorous (?) elephants once exhumed here."

Coal exists at Cirnaga de Oro, on the River Sinu; on the banks of the Carare; at Conejo, below Hondu; also near Bogotá, and is used at Mr. Wilson's iron-works. It also occurs in Veraguas, Chiriqui, and Costa Rica, and on the Isle of Muerto, and at Tarraba. The coal is probably,

* The castellano is 1415 grains.

like that of Chile, of tertiary age, excepting, perhaps, that of Bogotá, which may be of the carboniferous or even cretaceous period.

Gold, the yellow representative of earthly riches, at once the blessing and the curse of life, in this auriferous land appears before us everywhere, ornamenting the clothes of the living and decking the bodies of the dead, covering wooden idols and hanging as jingling bells from the branches of the sacred trees; tempting the avarice of the proud Spaniard to murder and to theft, and to gather glistening treasures which should perchance make him the prey of some stronger buccaneer. The mines of Spain are closed; even the Espiritu Santo, from which alone more gold yearly went through Panamá than from all the other mines of America put together. Then there is the gold-district of Coyba; the mine at Bogotá, the king's fifth from which was 300,000 dollars; the gold-dust of Panamá and Pacora; the mountain of the "Block of Gold" in the Cano del Pilon de Oro; the streams of the Chepo, where Major Don shovelled out the gold-earth by panfuls; and the thousands of graves in Chiriqui, abounding in golden images and earthen pots of gold beside the black dust of mouldered bodies.

So much for New Granada. Now for Equador or Quito. We have here too some geological gleanings. Coal is mentioned as occurring in Amortajado, and probably in Puna, Santa Clara, Santa Elena, and the coast of Choro.

Passing by Latacunga and the volcano of Cotopaxi, Quito, and the volcanic Pichincha, we come to the land of the mighty Chimborazo, rearing itself high above the chain of the Andes, like a majestic dome upon those ancient monuments. What mean those tales of giants which the Caras believe came to these coasts on floats of rushes, and were annihilated in their evilness by the wrath of God? Now that man's antiquity is proven, we must seek the interpretation of such old legends; for, like the Eastern fable of the elephant and tortoise, there may be a long-lost meaning in them. In the similitudes of these traditionary tales we shall see the race-badges of many an ancient people.

Whether Manta, the seaport to Monte Christo, has derived its name from the broad mantle-like fish which is said to squeeze the pearl-fishers of Panamá to death, is not to our purpose, but it is so to know that it has an emerald-mine, and that the emeralds are found in crystals in the rock, and have something of a vein-like character. "Some are half-white, others half-green, but they get ripe and come to perfection." At Tezcuco there was, in the "Tribunal of God," a skull crowned with an emerald.

At Manta, too, and Punta S. Elena, large fossil bones are met with;* some, so Humboldt states, being those of large cetaceans. Of gold, too, we get frequent accounts, in the form of abundance of ornaments. The entire range of the Cordilleras abounds with gold, silver, and copper, and the former metal is found in every river which has its source in the high lands; the mountain-range of Llanganate (S.S.E. of Quito) is known as the "mother" of the gold found in the streams that run from it. Quicksilver is seen to ooze out of the ground in Cuenca; and the district of Esmeraldas only requires searching in its streams and rocks for the beautiful gems from which it takes its name. But where is the far-famed mine from which the ancient rulers of Quito drew those gigantic emeralds so valued by the Conquistadores, and some of which are treasured as the crown-jewels of Spain. That it exists there is no doubt; but the Indians, if they know the spot, conceal it. An emerald as big as a hen's egg fell into the hands of Pizarro's followers: cannot modern adventurers find it

* The occurrence of these remains is also referred to in a paper in the Geographical Society's Journal, xx., 1850.

out? The beryl, with sky-blue and green emeralds, is found too in the Cordillera of Cubellan. It is often said that Peru is rich in emeralds, but Mr. Bollaert says that this should rather be said of Equador, as he has never known that gem to have been found in the former country. As the eleventh Inca, who died about A.D. 1475, commenced inroads on Quito, his son Huagna Capac conquering the country, Mr. Bollaert thinks this was the period at which the Peruvians became acquainted with the emerald. Parisite, a brownish-yellow crystal, composed of carbonate of lanthanium and didymium, with fluoride of calcium, is also found in the emerald-mines of Muzo.

We know nothing as to the process the natives of Quito or Peru have for cutting, boring, or polishing precious stones; they may have had hardened copper or brass instruments, and something approaching the drill, for the regal emerald had holes drilled through it to keep it fast on the head. Wallace, in his 'Travels on the Amazon' (1853, p. 278), in his account of the Uaupés Indians, speaks of seeing "several men with the most peculiar and valued ornament—a cylindrical, opaque, white stone, which is quartz imperfectly crystallized. These stones are from four to eight inches long, and about an inch in diameter. They are ground round, and flat at the ends,—a work of great labour,—and are each pierced with a hole at one end, through which a string is placed to suspend it round the neck. It appears almost incredible that they should make this hole in so hard a substance without any iron instrument for the purpose. What they are said to use is the pointed flexible leaf-shoot of the large wild plaintain, triturating (twirling with the hands) with fine sand and a little water; and thus no doubt it is, as it is said to be, a labour of years. Yet it must take a much longer time to pierce that which the Tushua (chief) wears as the symbol of his authority, for it is generally of the largest size, and is worn transversely across the breast, for which purpose the hole is bored lengthways from one end to the other, an operation which it is said sometimes occupies two lives. The stones themselves are procured from a great distance up the river, probably from near its source at the base of the Andes; they are therefore highly valued, and it is seldom the owners can be induced to part with them, the chiefs scarcely ever."

In Wilkes's 'American Exploring Expedition,' it is stated that, "on Bowditch Island, in the Pacific, the hand-drill is used, pointed with hard stone, for drilling shells." "Could such an adaptation," Mr. Bollaert asks, "have been employed by the emerald-drillers of Mexico, Bogotá, and Quito?"

When Mr. Bollaert gossips about the Incas and the old Peruvians, it is hard not to digress, the subject is so enchanting; but we draw the bonds of our speciality closer and resolutely resist. And that we may not be allured, we bridge over this part with a string of the Captain Cuttle sort of extracts.

"There was some quillay or iron-ore particularly at Cuancha; but it was not smelted by the Indians, that being too serious an operation for them. Gold and silver were merely melted, but the chloride and sulphuret of silver, by the aid of fire and air, could be reduced by them."

"In vol. i. 'Mercurio Peruano,' p. 201, A.D. 1791, the following mines are mentioned as having been worked by the Incas:—Escaméra, Chilleo, and Abatantis, of gold; Choquiniñá and Porco, of silver; Curahato, of copper; Carabuco, of lead (probably the vicinity of Oruro yielded tin); and the magnificent iron-works (!) of Ancorianies, on the east margin of Lake Titicaca, are particularized."

"Cope, a mineral pitch, is found near Point S. Elena, and Amotape, near Piura. It abounds in Realejo, and at Chumpi, near Guamanga in Peru."

"At the foot of the mountain of Curataqui is a cavern, and from the number of bones of children and animals met with, was probably a place of sacrifice. . . . Walls, ruins, and roads are seen in many parts of Equador, in the plains, sides of mountains, and on their summits; the more irregular are thought to be the work of people long before the conquest of the country by the Incas."

Peru and Bolivia now claim attention. A sandy desert runs along the whole extent of coast from Tumbez to Loa. The western Cordillera is ascended by rugged paths to an elevation where the frozen Andean plains or paramos are found, out of which rise the colossal peaks of the Andes, covered with eternal glaciers. From the burning heat of Egypt to the icy cold of Siberia, there is here every gradation of climate. "In the valleys of the coast, and those of the interior, *all the species of quadrupeds and domestic birds known in Europe are now bred.*"

In Bolivia we have the rich barilla or native-copper mines of San Bartolo; and in the desert of Atacama, Dr. Philippi places the region of meteoric iron. Near Rosario are ancient gold-mines; at Olarios, nuggets have been found of from eighteen to thirty-seven ounces. Copper and gold is worked at Conche; silver, iron, alum, sulphur, salts, borate of lime, and nitrate of soda. Guano is found at Argamo and San Franscisco on the coast. The mines of Potosi—world-wide is their fame! "The City of Silver" is 13,320 feet above the sea, and the "Silver Mountain" top 15,200 feet. The mines of Conche supply the copper hammers for its busy miners. Up to 1846, the 'Anales de Potosi' tells us, £330,544,311 was the value of the precious metal extracted from its mines.

Lipes and many another district are rich in silver mines; in gold and copper; salt-plains there are too, and lakes. In Tariga fossil bones of mastodons and mammoths are found in various places, and gold and silver are said to be met with in the mountain of Polla. But we shall fill page after page if we state half the places in this rich region where gold and silver are recorded; and those who want to know more details—we think we have given enough—must consult Mr. Bollaert's cyclopædia of facts, for such his book really is.

It may not be written with that continuous flow of pleasant diction which gives such a charm to some books of travel; but it is one of the densest masses of facts we ever perused. For any defects of language, we may observe, we should bear in mind that Mr. Bollaert is not an Englishman; and when we remember this, we shall be more inclined to take an opposite course, and wonder at his generally accurate knowledge of our tongue.

Essai d'une Réponse à la Question du Prix proposé en 1850 *par l'Académie des Sciences pour le concours de* 1853, *et puis remise pour celui de* 1856. Par M. le Professeur Bronn.

The task which the successful candidate for the above prize had to accomplish was "to examine the laws of the distribution of organized fossil bodies according to the order of their superposition in the various sedimentary deposits; to discuss the question whether their appearance or disappearance was successive or simultaneous; to seek for the signification of the relations between the existing state of the organic world and its anterior states." This task, which to perform successfully would require the most universal knowledge of fossil and recent organisms, and in which

TABLE I.—SHOWING THE DISTRIBUTION OF SPECIES ACCORDING TO THE ELEMENTS IN WHICH THEY LIVE.

SUBKINGDOMS.	(Phytozoaria) Aerita.			(Actinozoaria) Radiata.			(Malacozoaria) Mollusca.				(Entomozoaria) Articulata.			(Spondylozoaria) Vertebrata.				Animalia.
PRINCIPAL CLASSES.	Spongiaria.	Polygastria.	Polythalamia.	Polypi.	Acalepha.	Echinodermata.	Bryozoa.	Acephala.	Gasteropoda.	Cephalopoda.	Annulata.	Crustacea.	(Insects.)	Fishes.	Reptiles.	Birds.	Mammalia.	$\frac{78}{4}$
Living on land	...	*	..	...	...	...	...	...	1	...	*	*	4	...	3	4	3	15
——— in fresh water......	*	? 3 !	...	*	...	...	...	1 !	*	...	*	*	*	1 !	1 !	*	*	6
——— in the sea...........	4 ! !	? 1 !	4 ! !	4 ! !	4 ! !	4 !	4 ! !	3 !	3 !	4 !	4 !	4 !	*	3 !	*	*	1	47
Approximative number of living Species	250	500	1000	1000	250	600	1000	4500	13000	250	1000	1000	68000	8000	1100	8000	2230	111,650

the great problem of the origin of species was indirectly involved, was undertaken, in the year 1856, by two candidates.

One of these treated the question in a summary manner; he merely examined a few very limited points of the question, and not the whole series of the facts, which the Academy required of him. Accordingly, in spite of many ingenious views, which were rather geological than palæontological, the Commission, which consisted of MM. Elie de Beaumont, Flourens, Isidore Geoffroy St. Hilaire, Milne-Edwards, and Ad. Brongniart, declined to receive the memoir into their consideration.

The other memoir, bearing the significant inscription, or epigraph, *Natura doceri*, being a quarto volume of nearly five hundred pages, with numerous tables, received the prize of the Commission, and has been since published both in the German and French languages.

The French translation is now before us; and we must regard the publication of this magnificent work as forming an era in palæontology. Any *précis* of the argument of the author is clearly impossible. We give a few of the tables which Professor Bronn employs, as specimens.

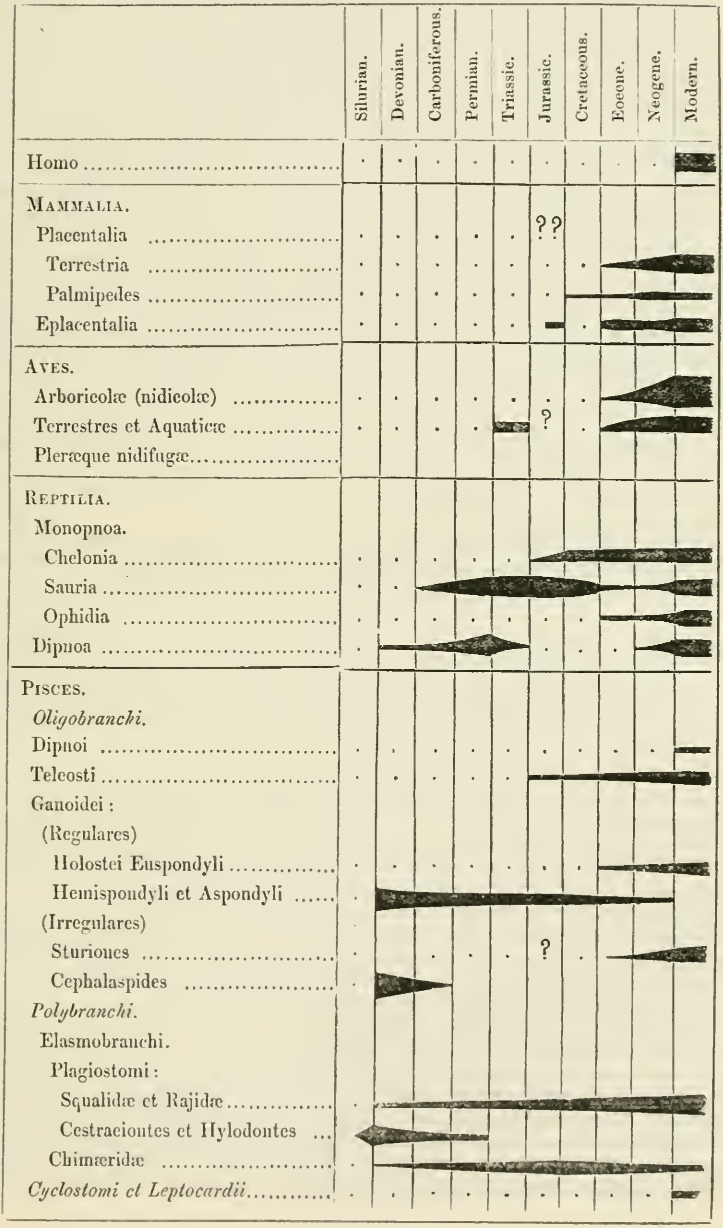
Professor Bronn lays it down as a rule that *omne ens ex aqua* (all beings have their origin in fluid), which he says is true not merely as regards individual beings, but as regards sub-kingdoms and even kingdoms. To exhibit this truth more clearly, he offers the Table No. 1, where the proportional numbers of the inhabitants of the sea, the freshwater, and the dry land are indicated, in all the classes of the animal kingdom, so that each class is represented in its entirety by the number 4, and it is indicated in each class of one, two, three, or four, if its genera or species inhabit the one or other of these elements; those media of existence which only number a few isolated inhabitants, being indicated by an asterisk (*). Bronn adds the sign (!) when respiration by gills exist, and the double sign (!!) when no specialized respiratory organ is developed.

TABLE II.—Showing the Balance of Power between the Carnivorous and Phytophagous Animals.

(*Plant-eaters—Phytophaga.*)	(*Flesh-eaters—Sarcophaga.*)
Insects.	
Myriapoda. Trachearian Arachnids in small number. Hexapoda; many Diptera, all Lepidoptera, Hemiptera, Orthoptera, half the Hymenoptera, nearly all the Coleoptera.	Arachnids, the majority. Hexapoda; many Diptera, most Neuroptera, half the Hymenoptera, some Coleoptera (Carabici), feed on other insects.
Reptiles.	
Sea-turtles.	Most of the terrestrial types.
Birds.	
Some Natatores and Grallatores, most Gallineæ, Pigeons, many granivorous and frugivorous Passeres; Nectariniæ.	Most Natatores and Grallatores, Insectivorous Passeres; Birds of prey.
Mammalia.	
Sirenia, Ruminantia, part of Pachydermata, Glires, most Bruta, some Cheiroptera, most Marsupials and Quadrumana.	Some Bruta and Marsupials, most Cheiroptera, Insectivora and Carnivora, some Quadrumana.

TABLE III.

SHOWING THE DISTRIBUTION OF VERTEBRATE ANIMALS IN TIME.



He concludes in the following manner:—"The results arrived at repose on the momentaneous state of our positive knowledge of the fossil world. New discoveries may modify them, and perhaps even change some of their details. But the general laws which we have established are based now on too large an amount of facts to permit doubt of their reality, or fear lest some exceptions of inferior importance may refute them entirely. We cannot pretend that Nature, although actually following the indicated method during creation, has never made an exceptional step, for reasons which remain to us unknown. The phenomena in question are not of a nature to be able to be assigned to fundamental laws, with the same certainty and rigour as physical or chemical facts, which can be calculated according to the laws of attraction and affinity, or perhaps the causes which have produced them are too complicated to permit us to recognize them perfectly. If the same rigorous law was the sole cause of all these facts, the knowledge of extinct populations which the fossil remains in the earth's strata furnishes to us would always remain defective, as we shall be never certain of knowing all the facts, which are of such importance to enable us to formulate exactly the expression of our belief. Whether the results to which we have at present arrived satisfy us or not, we have only searched for truth, and announced what we have discovered. Even when constructing *à priori* a series of theoretical laws, we have not sought to establish a preconceived opinion; our object was to establish a method which would lead us to reply to all the questions in relation to our problem. Before accepting these theoretical laws, we were bound to make rigorous observations, which we see confirmed by facts. For our motto has been for many years, and ever will be, *Nature will teach*."

If the principles actuating such noble sentiments as these were practised by all palæontologists, England might hope for a brighter future in its scientific world than promises to dawn upon us for many years.

The Theology of Geologists, as exemplified in the cases of the late Hugh Miller and others. With an Appendix on the Nature and Properties of the Torbanehill Mineral, by Hugh Miller. By William Gillespie, Author of 'The Necessary Existence of God,' etc. etc. Edinburgh: A. and C. Black.

It is wellnigh impossible to conceive the present creation devoid of man as its governing spirit. We almost inseparably associate the idea of animal life with intelligence and reason. Were they thus united in the palæozoic ages? If this conjunction be necessary, it must have existed from the dawn of life,—and so, we by no means prejudge the question as to man's antiquity, or the existence of a pre-Adamic race.

If the further researches of animal psychology should substantiate such a connection as we have indicated, we may expect to arrive at as strange conclusions regarding psychical life in the geologic æons, as those which the researches of Cuvier and Owen into the animal structures of the past have revealed. In thus anticipating deeper glimpses into the economy of the past than any yet attained from the mere study of fossils, we by no means wish to resuscitate the fantastic dreamings of some cosmogonists of the sixteenth century; but would only remind geologists that animal psychology is as truly an inductive science as any observational one. Laws inseparably linking the physical and psychical life of organized beings may yet be established; and these will extend over past as well as present life. The psychologist, then, may yet include fossils under his cognizance. And the conclusions he may arrive at regarding the instincts and habits of the primæval animals may be as certain as those of the palæontologist in reference to their structure. Again, as the psychical and moral are intimately associated, the theologian, too, has claims on past life. Physiology expressly indicates a connection between physical and moral law; while Scripture as expressly declares it. And so an inquiry such as we have indicated, so far from being trifling or minute, interlaces itself with questions of the most momentous importance.

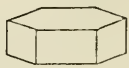
The existence of such organisms as a lion's paw or the jaw of a shark, so wondrously adapted for the purposes of rapine in a creation otherwise filled with evidences of the utmost benevolence, has led most natural theologians to conclude in the existence of an active principle of evil. This is strengthened by the statements of Scripture regarding the tree of knowledge of good and evil, as well as the recognition by the Saviour, both in his miracles and in his didactic statements, of the power of the arch-enemy over physical nature. The evidences of death by violence in the geologic eras have given an additional importance to this inquiry. Did some disturbing moral element prevail in the old creations of the past? is a question affirmed and denied by equally competent writers. The pamphlet at the head of this article is perhaps the best original exposition published in this country on the affirmative; while the two works it specially combats—those by Hugh Miller and Paton Gloag—are the best representatives of the opposite side of the question. The learned German theologian Kurtz has perhaps most fully discussed this topic; he shows that not only the past history of our globe, but also that of the whole universe, may be intimately connected with moral dynasties in which Satan and his angels mingled.

Mr. Gillespie affirms that geology can only bear witness as to the existence of the carnivorous monsters of the past; and that the theologian alone has the right to discuss the reasons why they were furnished with such implements of rapine and destruction. Hugh Miller, on the contrary, founding his whole argument of the 'Testimony of the Rocks' on the doctrine that the Mosaic creation is that referred to by geology, affirms that as all these past creations were pronounced "very good," so these animals must have come direct from the hands of the Creator. Whether or not Miller has in this case departed from his usual philosophic style, our readers must judge. But to do this they must hear both sides; and they will find in Mr. Gillespie's pamphlet ample material on a topic which will occupy more than it has done the thoughts of speculative men.

A Glossary of Mineralogy. By H. W. Bristow, F.G.S., of the Geological Survey of Great Britain. London: Longman and Co., 1861.

The public waited a long time for this work, and it has proved worth waiting for. To have a cheap book is something; to have a good book is better. But to have a book at once cheap and good is to have all we can desire of author or publisher. The preface opens by telling us it was undertaken to supply a want which the author had often felt—and, we may add, how many others? Having felt it himself, is fortunately, perhaps, one reason of his success in supplying the concise handy manual which meets that want, and will make the stony road of mineralogy more easily trodden by future students. The work is arranged on the plan of a glossary or dictionary, with a capital introduction giving the general characters of minerals, followed by an excellent table of classification. The general characters of minerals of course are those which relate to external form and structure, and characters dependent on light; these are divided into optical properties; physical properties; other characters, such as streak, taste, odour, etc.; characters dependent on cohesion; chemical characters; all of which are briefly but intelligibly explained. The system of classification adopted is that used by Mr. Warington Smyth in his lectures at the School of Mines, and the division is primarily into Non-metallic and Metallic minerals. The former into the five classes of—1. Carbon and Boron; 2. Sulphur and Selenium; 3. Haloids and Salts; 4. Earths; 5. Silicates and Aluminates. The latter into four classes—1. Brittle and difficult of Fusibility; 2. Brittle, easily Fusible and Volatile; 3. Malleable, not reducible by heat alone; 4. Noble Metals, reducible by heat alone. This is followed by a list of symbols and signs, and explanations of the technical terms used by jewellers and lapidaries. The book consists of 420 closely-printed pages, and is teeming with outline illustrations, small, but carefully executed. As a sample of its plan a single extract will suffice, and at the same time will probably convey information to some of our readers:—

"CHLORITE, *Werner*. Hexagonal; occurs in tabular six-sided prisms. Colour various shades of dull emerald-green in the direction of the axis, and yellowish o hyacinth-red at right angles to it; also pure white or yellowish. Massive varieties olive-green. Semi-transparent to sub-translucent. Lustre pearly; yields to the nail, and when in powder is unctuous to the touch. Streak corresponding to the colour. H. 1 to 1·5. S. G. 2·7 to 2·85. Compact chlorite is amorphous. Chlorite-slate posseses a slaty structure, and frequently contains imbedded octahedral crystals of magnetic iron, hornblende, and garnets. Earthy chlorite is composed of small pearly, glimmering, scaly particles. It has a somewhat greasy feel, and bears a striking resemblance to Green Earth.



Composition. 4 $(\dot{M}g\ \dot{F}e)$, $\dddot{Al}$, $\dddot{Fe}$, 2 $\dddot{Si}$, 3 $\dot{H} = 4\ \dot{M}g\ \dddot{Si} + 3\ \dot{H}$.
Analysis, from the Pyrenees by *Delesse*, Silica 32·1, Alumina 18·5, Magnesia 36·7, Protoxide of Iron 0·6, Water 12·1 = 100·0.

Chlorite frequently contains as much as 8 or 9 per cent. of protoxide of iron; those kinds which have more (up to 28 or 29 per cent.) are classed with Ripidolite. Before the blowpipe some lose their colour and fuse at the edges; with borax affords an iron-reaction.—*Localities.* The tin mines of Cornwall, where it is well known by the name of *peach*. Also in Cumberland and Westmoreland, and near Llanberis in Caernarvonshire. At Portsoy, in Banffshire, it is mixed with Serpentine, and is frequently cut and polished.—*Name.* From χλωρὸς, green. This mineral may be distinguished from mica by its laminæ being flexible but not elastic, while those of mica are very elastic. It has been proposed by Descloiseaux to divide chlorite into three groups, Pennine, Clinochlore, and Ripidolite; to which may be added Leuchtenbergite.—*Specimens.* British Museum; Case 52. Museum of Practical Geology; Horse-shoe Case, Nos. 1039—1043, 1047."

In this little book also the various names used by different authors have been introduced, as well as certain terms which, although now obsolete, are very useful for reading the works of the older mineralogists, in which they constantly occur; while the copious lists of synonyms are very valuable to the student in perusing the works of foreign authors. We could say much more of its merits. It is very easy to "cut up" a bad book, but it is by no means so easy to say properly all we would of a good one. We can recommend Mr. Bristow's book to our student-readers; and, as its price and dimensions bring it within the reach of every one's means, we advise them to test the value of our praise by buying it and reading it.

RECENT SPONGE, ILLUSTRATIVE OF THE FOSSIL CEPHALITES OF THE CHALK.

(In the Collection of Dr. Bowerbank.)

S. J. Mackie, F.G.S., del.

THE GEOLOGIST.

MAY 1862.

WHAT ARE THE VENTRICULITES?

The question which heads this article is not a new one. An old one, indeed, it is; and, common as chalk flints and chalk ventriculites are, it does not show much energy on the part of cretaceous—we do not know how else to single them out—geologists and palæontologists, that this old question has never yet been answered.

The only man who has ever worked properly on the subject is Mr. Toulmin Smith, who many years ago laboured hard and well on these curious organisms, and then retired on his laurels. But Mr. Smith, like all men who have devoted themselves to a special subject, is full of prejudices—we do not mean to say errors—and no progress in our

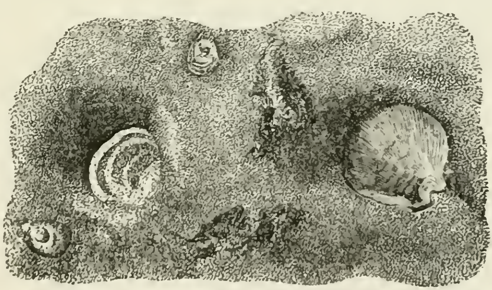


Fig. 1.—Portion of Flint Nodule, with shells attached to Ventriculite.

knowledge can be hoped to be made until these prejudices are attacked. Mr. Smith, having *built* his castle, is not likely to strengthen it until its walls have been undermined, or at least have been battered by the artillery of able antagonists. Dr. Bowerbank is considered to be the only powerful opponent of Mr. Smith's views; but whether the Doctor has expressed his opinions in print or only verbally in ordinary conversation, we do not know; at any rate, the world believes the amiable philosopher of Barnsbury Grove to differ in opinion from the ventriculite-anatomist of Highgate Hill. Mr. Smith believes them to be highly-organized polypidoms, which in their living state were covered over with tentaculated polypes, or that at least were studded with hundreds of tentacle-surrounded heads, ever waving their tiny arms, and catching and feeding upon the tiny prey or on fragments of animal substances which came within their clutch. What Dr. Bowerbank believes them to be we need not say is—sponges.

Now we quite agree with Mr. Smith in one of the opening remarks of his articles printed in the 'Annals of Natural History' in 1848, "that the knowledge of any creature is not merely the sight, or bare handling, or even the giving a name to a specimen; it must imply some knowledge of structure or functions." Now Mr. Toulmin Smith did not rest content with seeing and naming these curious organisms, but he spent weeks at the Burnham chalk-pits, near Maidstone, in collecting them, and months in slicing the hard flints, in which the organized structures were best preserved, with the lapidary's wheel, and painsfully examining thin slices and polished surfaces under the microscope. He did more than this. In the chalk, as in the flints, the fibres of the ventriculites are preserved in threads of sulphuret or oxide of iron, and by dissolving away the soft chalk with weak acid, he left the iron-threads standing out free from their calcareous matrix, and exhibiting a model in metallic rust of their former natural structure. In these ways he developed a condition of inosculating fibres in some specimens, which then presented an extraordinary anomaly in animal structure—and which remains, we do not hesitate to say, an anomaly still. These fibres were seen to form the outlines, so to speak, of octahedrons. Straight in themselves, they first crossed each other, and then these joints were cross-braced by other fibres, as in the following fig. 2. The whole organism was seen thus to be made up of a webbing or tissue, all the joints of the crossing threads of which were cross-braced and strengthened in this remarkable way (fig. 3); so that, of the finest, and perhaps most

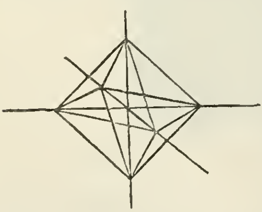


Fig. 2.

brittle, thread-wires, a structure of the most delicate nature was reared, and made *rigid* enough and strong enough to stand erect against the gentle currents which flowed over the deep bottom of the cretaceous sea. It is not our purpose here to describe the species of ventriculites, brachiolites, and cephalites which Mr. Smith has recognized; but we want to know what ventriculites are, or at any rate to gather some more information about them than is at present possessed. Just as into the Infusoria naturalists put every sort of organism whose nature they do not understand, so geologists and palæontologists have cast on their "muck-heap"—sponges—every sort of round, funnel-shaped, or stemmed and ball-headed fossils which they have not knowledge enough, or have not taken the pains to place anywhere else.

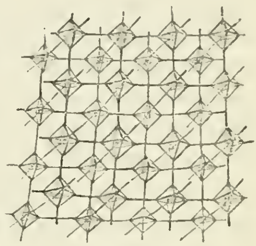


Fig. 3.

Now, if Mr. Smith be right in his account of this cross-braced structure and in the interpretation he has put upon it, the ventriculites cannot be *sponges*. Spicula we have in sponges, but spicula are always lying loose, never cross-braced by actual junctions. Moreover, sponges are of amorphous structure—they are typical of the group AMORPHOZOA; and a hundred-head tenticulated animal is not amorphous.

The case at the present hour stands much as it did fourteen years ago—namely, thus: Mr. Toulmin Smith, by devoted and admirable efforts, examined, arranged, and gave a nomenclature to these ventriculites; and after a most rigid inquiry—carried a great way towards perfection, but never perfected—asserted these characteristic fossils of the chalk to have belonged to highly organized creatures, at least approaching to the grade of the lower Polypifera. Then Professor Morris, in his 'Catalogue of British Fossils,' adopting Mr. Smith's nomenclature and generic and specific arrangement, replaced the ventriculites in the Amorphozoa, without any written reason—such, it is but justice to say, not being within the scope of his book—and without having, as far as we know, in any other publication disputed Mr. Toulmin Smith's facts.

Professor Morris's dictum might have been taken when he first published his 'Catalogue,' many years ago; but the dictum or judgment of no man ought to be taken in this year of grace 1862, when no living man is equal to the acquirement of a universal and perfect knowledge of the progress of the sciences.

Neither must we take Mr. Smith's dictum nor Dr. Bowerbank's. We must take the evidence before us. How does this stand? Mr. Smith has seen this octahedral structure in some species and he *applies* it to all. But he has not proved it by actual examination, he has *not seen* it in every case. Dr. Bowerbank, who has lent us the beautiful specimen of recent sponge which we figure (Plate IX.), as presenting such a marvellous resemblance in its corrugations to certain species of cephalites, we think, does not believe in the octahedral structure occurring in all the species of ventriculites, brachiolites, and cephalites; but then we are not aware whether he or any one else has ever examined, certainly no one has ever figured, the rudimentary structures of every species of those interesting groups.

What we want, in the first place, then, is a thorough definition from some zoologist or palæontologist of what are the marking characters of a sponge. As far as we ourselves can make out, sponges are amorphous animals of a globular form, or of some modification of a globular form, such as funnel-shaped, stemmed with a disk-like or ball-like head, or convoluted. They may even be angulated, like the *Guettardia angularis* of the chalk group of ventriculites; for the modifications of the true sponges may be regarded as modifications of the natural tendency in the true spherical sponges to form a large central perforating canal, the enlargements of which or of its walls, combined with various kinds of constrictions in them and the elongation of the sponge's attachment-part into a stem, are capable of giving rise to every known modification of true sponge. There is nothing therefore in the various and sometimes intricate shapes of the Ventriculidæ to militate against their being sponges. But if Mr. Smith's *octahedral structure* is to be met with in all, then they would seem *not* to be sponges; and if only some are thus constituted, then these few must most probably be taken out of that family, for it is *not likely* the animals which clothed such elaborated skeletons were —what those of sponges must be—*amorphous*.

Some one of our young geologists who wants to acquire name and fame should set to work collecting in flint and in chalk specimens of *every* species exhibiting structure. The flints he should cut up into thinnish slices, or slit them through, and polish their surfaces for microscopic examination, and the chalk specimens should be cleared out with acid, as Mr. Smith years ago did, but we regret no longer *does*. Careful drawings of the structure of each species should be made, and the evidence of their accuracy—the original specimens from which they were made—religiously preserved.

Then, and not till then, shall we have the proper data for replying to our question, WHAT ARE THE VENTRICULITES?

We would say a few words on the *rigidity* of the ventriculites. We know there is a tendency amongst geologists to consider the ventriculites as of flexible structure when living. This notion, originating with the late Dr. Mantell, has been perpetuated by their occurrence as fossils in every variety of shape, apparently of dilation or contraction. On the other hand, it has been urged that the attachment of oyster and dianchora shells and serpulæ prove that they must have been rigid, because otherwise such parasites could not have lived and grown on them, as the growth-lines of such shells prove them to have done.

For our own part we do not see the force of either argument, for the apparent expansions and contractions may be, as we believe them, a mere accidental kind of growth of the ventriculite, which had a general tendency to flatten or become disk-like with age. We are not aware that any closer approximations of the constituent fibres in the so-regarded contracted specimens, or of their dilations in the equally hypothetical expanded ones, has ever been observed; and, moreover, such a complicated and *braced* structure, which is pointed to as a wonderful example of the Creator's engineering skill to produce a comparatively strong framework out of the slenderest materials, would lose its apparent object, and certainly must have been one of the most awkward and intractable of any which could have been conceived for such a purpose as elasticity or flexibility.

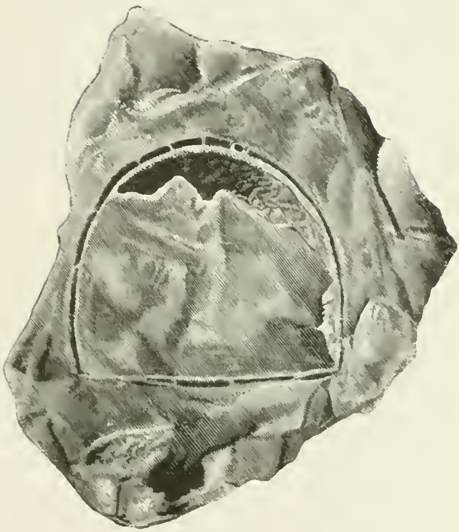
As to the growth of shells upon ventriculites, of all the examples we have seen, and they are many, most were decidedly attached to *dead skeletons*. Some few we have seen pitted by the marks of the corrugations and pores of the skin, and such evidently shows that the oyster or dianchora grew on the living ventriculite, the fry fixing themselves most probably, in the first instance, in the interspaces between the pores, if the ventriculite was a sponge, or between the tentaculated heads, if the ventriculite was a polypiferous organism. In some instances, and we figure an example (see fig. 1, p. 161), the oyster or dianchora growing for some time on the living skin, grew on after the death of the ventriculite; for, if Dr. Bowerbank's theory of the sponge-origin of flint be true, and it certainly is the best hypothesis yet propounded, the amorphous sponge growth enveloping the ventriculite, and since converted into flint, was prevented growing over those shell-fish by the currents produced by their gills, and the motive action of their unattached valves in opening and closing; consequently their attached shells are found *uncovered* in somewhat deep depressions, or rather hollows in the flint nodule.

The attachment of some very young oysters on the raised portions of the piece of flint nodule we have figured at a later period, either on the enveloping sponge after its life was arrested, or on the hardened surface of the nodule itself, is an excuse or a reason (whichever the reader pleases) for a slight digression on the formation of flint, and which we should not make, did we not desire to figure a very instructive specimen from the collection of Dr. Bowerbank (Plate X.). It consists of the shell of a galerite imbedded in flint, a very common occurrence, though not commonly met with in such an illustrative manner.

The shell evidently must have been *supported*, for the flint extends far beneath it. It could not have rested three or four inches above the cretaceous mud without something tolerably solid underneath to uphold it. A sponge would do this effectually; silex in a dense gelatinous state would also support it, but then the gelatinous substance would yield to pressure, and the shell, or whatever it was which rested on it, would incline to one side or other, according to its natural angle of rest. In the example figured, a sponge has grown all round, and covered with a plastering or film the whole of the interior of the galerite, while the life-existence of it was cut off or its growth arrested for want of a proper circulation of water, when the more dense mass of sponge which grew up from the floor of the galerite attained two-thirds the height of the cavity. The growth of the supporting sponge went on outside the galerite in a flourishing condition, and the shell was at last wholly and thickly enveloped.

Then the hardening into flint went on, and after the nodule had been formed the calcareous shell-matter of the galerite was slowly dissolved out—for water percolates even flints—and a cavity was formed between the thin inner film of sponge or flint and the flint cast of the exterior of the shell. This thin inner film is most valuable evidence here, for we could not account for it by the gelatinous deposition of silex, while we can explain it by the growth of sponge. It might, it is true, be formed by the oozing through the shell of the galerite of water containing minute quantities of flint in solution. But then its evenness over the roof and sides alike would be a little strange.

From the consolidation of flint around the lower parts of the stems and roots of ventriculites, much of their former living nature



SECTION OF PEBBLE WITH CAST OF A GALERITE, ILLUSTRATIVE OF THE SPONGE-ORIGIN OF FLINT.

[illegible], F.G.S., del.

is still to be learnt; and the subject we have now appended to our more legitimate remarks is by no means so irrelevant as at first sight it might seem. It is a common thing to find the roots of ventriculites covered over with a nodule of flint, in which holes are seen, through which the finer ends only of the separate rootlets have protruded. If these flints were originally sponges, first growing round the stems and roots of young ventriculites, then their very peculiar character is at once explained. But it is not by any means easy to imagine how a gelatinous mass of silex could consolidate under roots which in that case must have been *imbedded* in the chalk mud before any segregation of silicious matter took place *beneath* them. Moreover, such sponge growth will explain the plugs of flint which fill the central cavities of ventriculites, and the annular disks and rings which sometimes form bands round their conical exteriors; and we cannot but think some facts are from these sources to be elicited which shall have a practical bearing on the habits and living nature of the ventriculites.

FURTHER DISCOVERIES IN HEATHERY BURN CAVE.

By John Elliott, Esq.

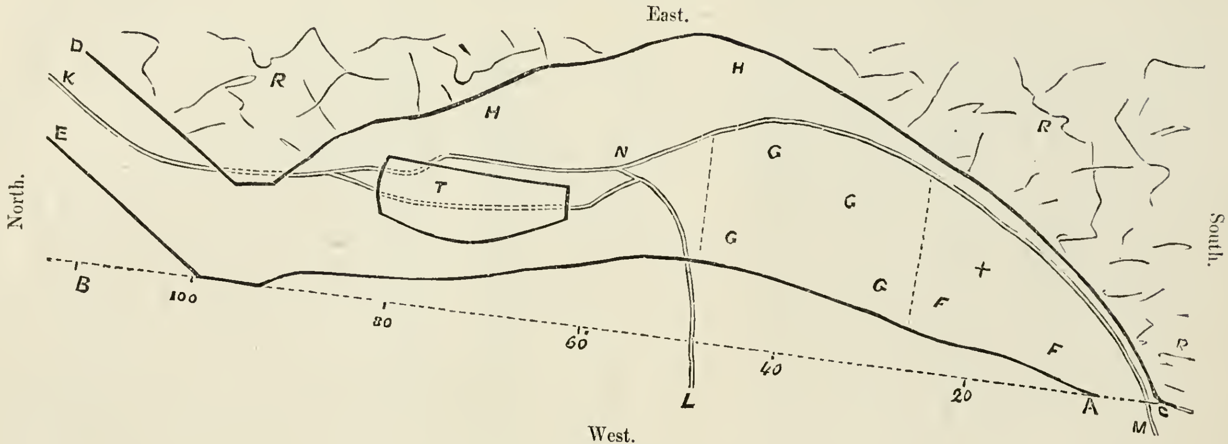
Since the publication of my paper "On the Discovery of Human and Animal Bones in Heathery Burn Cave, near Stanhope," in the 'Geologist' for January last, there have been further very important discoveries made in that cave.

In carrying on the quarrying operations from the point where they were suspended (see F*—fig. 1) when the first discovered relics were sent to London † the workmen found numerous fragments of bones, also bone pins and knives, fragments of very rude pottery, portion of an armlet, boar-tusks, bronze spear-head, pins, celts, and armlet, two coins, some marine shells, cockle, limpet, and mussels, and large quantities of charcoal, etc., all deposited under an incrustation of stalagmite, varying from 2 to 4, or at some places to 8 inches in thickness, with the exception of one or two manufactured articles, which were found in the sand not covered by stalagmite. The whole of the cave-deposits, with this trifling exception, were covered by a thick sheet of stalagmite, varying from a very dense, compact structure, to a highly crystalline, or to a more or less porous substance: some portions easily fractured by the stroke of a hammer, others yielding only to most energetic blows.

The bronze armlet and the two coins were found in sand uncovered

† Received by the Editor on the 14th of April.

Fig. 1.—Ground-Plan of Cave.



Scale 10 feet to the inch.

References.

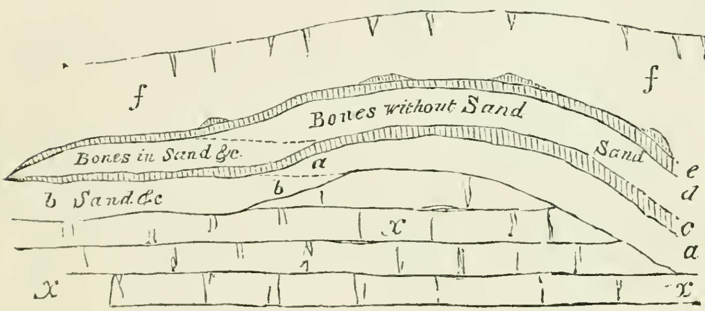
A B.—Base line outside the cave.
A C.—Width of cave where water issued.
A E and C D.—Sides of the cave.
F.—Where human bones, tusks, bone knives, bone pins, pottery, and portion of armlet were found. *No sand or pebbles*, but large quantities of charcoal found here.
G.—Bones, bone pins, tusks, pottery, etc., in coarse sand and smooth pebbles, with larger quantities of charcoal.
H.—Bones, bronze spear-head, bronze pins, in sand and pebbles, with large quantities of charcoal.
J.—Seven bronze celts, tusk, and bronze armlet, in sand, with charcoal.
K L.—Present watercourse.
M N.—Ancient ditto.

by stalagmite, but as they were deposited in what had, not long ago, been the watercourse, the stalagmite had either been denuded, or had been prevented from forming, at that particular place, by the action of the stream; the *coins were under very little cover*, and might have been imbedded very recently.

The stream of water through the cave has evidently changed its course many times since the cave was excavated to its present size, as we find accumulations of sand and gravel (at F* and G, in ground-plan, fig. 1), about three feet above the present water-level, and about two feet above the ancient watercourse (M, N).

At *a a*, fig. 2, there was a hillock of angular blocks, etc. covered by stalagmite, and upon this stalagmitic hillock were deposited bones,

Fig. 2.—LONGITUDINAL SECTION AT F. (See Ground-Plan.)



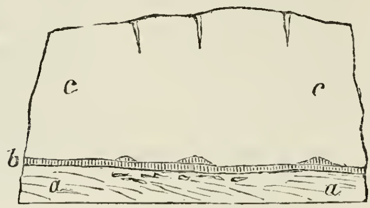
30 feet.

		ft.	in.
f.	Open cave	5	6
e.	Stalagmite	0	4
d.	Bone bed	1	2
c.	Stalagmite	0	3
a.	Angular blocks	2	9
		10	0
x.	Rock, limestone.		

tusks, bone knives and pins, large and small snail-shells, fragments of pottery, piece of an armlet, a cockle-shell, and large quantities of charcoal, cemented together by calcareous matter. No sand or gravel was observed amongst them; there being considerable interstices in some parts of the bed, plainly showing they had not been drifted there by water, but pointing to the conclusion that they had been *purposely* placed there by the animals or men that inhabited the cave. Part of these bones, etc., formed the subject of my former paper above alluded to, but no *manufactured* bones, etc., had been found when it was written.

At G, fig. 1, the bones, bone pins, tusks, pottery, and charcoal were found in coarse sand and smooth pebbles, and might have been drifted while *in* the cave, but it is not at all probable that they were drifted *into* it, for every appearance connected with the deposits, such as the large quantities of charcoal found, and the numerous burnt stones, etc., lead to the belief that the cave had been inhabited for a considerable length of time; and that fires had been burned at different places the thick deposits of charcoal testify.

The bronze implements found at H and J in fig. 1, were associated with a few bones, a limpet-shell, some mussel-shells, and a large quantity of charcoal, and were deposited in sand and gravel.

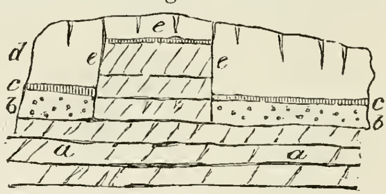


18 feet.

Fig. 3.—Transverse Section at G. *c*, open cave, 7 feet; *b*, stalagmite, 4 inches; *a*, and and gravel, bones, etc., 15 inches.

The deposits throughout the cave are nearly on the same relative level, with the exception of the hillock already mentioned; and while the greatest part of them have only one stalagmitic covering, the hillock and a few feet towards *g*, in fig. 1, had a sheet under the "bone-bed," extending over *b b*, fig. 2, where it vanished, and its place was occupied by sand and pebbles, as we see in the transverse section (fig. 3).

The "Communion Table," as it was called by the visitors to the cave, was a large pillar of the rock, around which the water had washed until it had undermined the base, when the pillar fell down, leaving a considerable space between its top and the roof of the cave, which had afterwards been partially refilled by pendulous stalactites from the roof, forming a junction with the stalagmitic bosses on the "table" (as shown at fig. 4); and on the top of the "table" there was found a tusk, some bones, some large snail-shells, and pieces of charcoal, under an incrustation of stalagmite. One of the workmen wondering what thickness the incrustation had attained on the "table," struck his hack into it, and exhumed the above-mentioned relics to his no small astonishment. Perhaps this is the first time that such a discovery has been made "on removing the cover."



18 feet.

Fig. 4.—Transverse Section at H, showing "Communion Table." *e*, "Communion Table; *d*, open cave, 4 feet 6 inches; *c*, stalagmite, 2 or 3 inches; *b*, sand, etc., 12 inches; *a*, rock.

The appearances of the deposit at F, fig. 1, and the great thickness of the stalagmite—in places 6 and even 8 inches thick—shows that portion must have taken a greater length of time to form than the rest, which was only 2 to 4 inches, while from the absence of any bronze implements, I am led to consider it of more ancient date; the probability also is, that bone implements would cease to be used when metal ones were introduced.

The general appearance, on entering the cave before it was demolished, was very interesting and grand. The fine pendent stalactites from the roof; the various round bosses of stalagmite undulating over the floor; the gurgling of the cave-stream; and the momentary droppings of water from the crevices and joints of the rock, gave the place a very solemn and enchanting aspect. What changes in the manners and customs of the human race have taken place since the date of the cave-men! Were we to take a poetical or an imaginative view of the case, and picture to ourselves a few naked or half-naked human beings in the gloomy cavern, standing or sitting round a fire made of wood, and enveloped in its stinking smoke, with perhaps an animal's skin flung round their bodies and secured by one of these very bone-pins we have found; making their rude repast of a boar which they had hunted down in the surrounding forest, and the flesh of which they may have boiled in one of their coarse earthen pots, of which we have found such numerous fragments,—flayed too, probably, with those bone-knives which have thus strangely come down to us; poor creatures, who lived and died so long ago, that no Hume has chronicled the career of their race, and who probably had perished ere Cæsar came to conquer: picture their condition of want, privation, and hardships, as compared with the plenty, the luxurious mode of living, and the high state of civilization which *we* now enjoy. What a contrast there is! But science does not sanction the play of the imagination, which is ever an unsafe guide. Well-ascertained facts and reliable observations are the data on which science rears the structures on which she plants her standards. But one can scarce refrain from speculation on a theme like this.

In conclusion, I beg to tender my warmest thanks to W. H. Ware, Esq., Ashes House, near Stanhope, who kindly permitted me to have the use of the relics until their history was made out, as far as can be done; and also to thank Mr. Richard Cordner, Crawley House, near Stanhope, for the interest he took in the matter, in generously sending men to carry on the explorations.*

West Croft, Stanhope, March 29th, 1862.

GEOLOGY OF THE ISLE OF MAN.

By Thomas Grindley, Esq., of Glossop.

While almost every week increases our knowledge of the geology of distant parts of the earth, there is one small island in the British seas, famed for its picturesque beauty, and peculiarly interesting on account of its historical associations, of the geological features of which very little is known, and even that little scarcely ever referred to in geological treatises. This may have arisen mainly from the

* These further most interesting discoveries were kindly forwarded to me by Mr. Elliott with this letter, accompanied by plans.—Ed. Geol.

fact of there having been as yet no official survey of this island; while those portions of the geological series represented in the Manx rocks having been typically established from other localities, it did not seem to present geological features sufficiently novel or peculiar to require any special investigation. Still, in the earlier years of the science, several eminent geologists did describe, with greater or less minuteness, some of its geological appearances: for example, Professor E. Forbes, who wrote a short account of Manx geology for one of the local guide-books; and a much more elaborate account was written by the Rev. J. G. Cumming, F.G.S., and published in 1848; but the rapid progress of the science, while it does not deprive these descriptions of all value, has in a great measure superseded them, and opened here a wide and almost untrodden field for the modern geologist. Having for several years resided on the island, and being convinced that many of the phenomena presented by the Manx rocks, if not altogether new to the geologist, are yet of remarkable interest, and capable of taking a great part in the solution of many of the problems which geologists are now endeavouring to solve, I have written the following brief account, with the view of diffusing, through the pages of the 'Geologist,' a more general knowledge of the geology of the Isle of Man, and in the hope of attracting to the subject that attention which it deserves.

Approaching the shores of the Isle of Man from the south-east, the whole of the island, with the exception of a small part of the north-west, too low to be distinguished at this distance, lies spread out before us; first, like a long ridge of blue cloud resting upon the misty horizon, which, as the vessel brings us nearer, shapes itself into the mountains and valleys, the rocky coasts and the secluded bays, of green Mona. Right before us opens out the beautiful bay of Douglas, hemmed in by the lofty headlands of Douglas Head and Banks's Howe, and relieved in the background by the highest peaks of the central range. Along the margin of the crescent-shaped bay, and capping the lofty ancient beach to the back of it, are numerous elegant buildings, the suburbs of the town, which itself lies clustered on a low triangular patch of alluvial land at the south extremity of the bay. Far away to the south we can distinguish in the distance the rocky islet of the Calf, with its numerous outliers, many of them worn by the waves of older seas into huge arches and long winding caverns, through which we may occasionally, even at this long way off, catch a glimpse of the bright sunlight. Between us and the Calf stretches a long line of rocky coast, with numerous tall promontories—Spanish Head, Scarlet Head, Langness, St. Ann's Head, and others—rising precipitously out of the green water, whose roar, as it dashes against the rocky cliffs or rushes up the numerous caverns, falls upon our ear like the hoarse voice of old Ocean himself welcoming to the sea-girt gem before us. To the north, we look along a similar line of tall cliffs and sheltered bays, until the view is closed in by the wild promontory of Maughold Head, beyond which nothing is seen but the heaving restless sea, dotted here and there, it may be, with a few fishing-boats, or darkened, perhaps, by the smoke of some passing steamer. Behind this long line of wild and picturesque coast rise the mountains of the great central range, occasional breaks in the tall coastline, as at Laxey, permitting us to see at a glance their vast proportions from their very bases to their cloud-capped summits. Far away in the north we can discern the sharp-peaked Barrule, and close to it the rounded head of the giant Snafield, appearing and disappearing as the wind drives the silvery mist across its grassy sides. Nearer still, we may mark the successive peaks of Bein-y-Phot, Garrachan, and Greebah. Directly in our front rises the pointed head of South Barrule, while in the south the range is continued through the sharp outlines of Irey-na-Lhaa, and the long swelling ridges of the Mull Hills to the Calf itself. We gaze long and earnestly on the glorious combination of the sublime and beautiful before us; but we rapidly close in with the shore—the dark cliffs tower higher above our heads, and cast a broader shadow over the clear green waves; and suddenly rounding the southern corner of the bay, we fire a gun, which is responded to from the shore, and almost at once we are in the midst of the throng and bustle of a fashionable watering-place.

The general axis of the island is from N.E. to S.W.: within this line rise the highest peaks of the mountain-range, and along its sides lie the upturned edges of the Manx rocks. At two points in this central axis the granite appears at the surface, probably in consequence of the overlying rocks having suffered extensive denudation—near the head of the Dhoon river, about half-way between Laxey and Ramsey, and on the eastern side of South Barrule. Between the granites of these two localities there is an essential difference, the Dhoon granite being a syenite, and of a much finer and firmer texture than that of Barrule. The granite of the latter locality is extensively quarried for economical purposes.

Resting upon the granite is a series of slaty rocks, which, as we recede from the central axis, passes regularly through the successive stages of mica-schist, clay-slate, and grauwacke-slate. Respecting the exact geological age of these rocks it is extremely difficult to speak, the few organisms hitherto found in them consisting chiefly of some imperfectly-preserved fucoids and corals—very uncertain guides. Still, taking into account the character of the lower portion of the series, which is undoubtedly metamorphic, and the regular passage into the upper and fossiliferous portion—and, further, from a comparison of the few fossils which have been found in this upper portion with those of other localities—it seems to be now admitted that the upper portion of these rocks is to be regarded as Lower Cambrian. One of the best-preserved of these organisms, obtained from the rocks of Douglas, and now in my own collection, has been lately identified by an eminent palæontologist as generically the same with an unnamed fucoid from the Cambrians of North Wales. These schists attain an enormous vertical development, probably not less than from 7000 to 10,000 feet. Their superficial development is also very extensive, extending over more than three-fourths of the whole island. Their strike is within a few degrees of N.E. and S.W.—that is, parallel to the mountain-range—but the direction and intensity of their dip is very various. Sometimes they dip seaward, as in the north of Douglas Bay; at other places they dip landward, as in the south of Douglas Bay; and in other localities, again, they dip in an intermediate direction, as in about the centre of Douglas Bay. The average intensity of the dip of these rocks is very great. At Douglas it varies from about 70° to 90°. At Langness it is from about 60° to 80°; and at Port St. Mary, still further south, it is almost equally great. At the foot of Garrachan, in the centre of the island, it is from 50° to 60°. Upon these and numerous other similar data I have founded my estimate of the thickness of these rocks. Their composition and texture is also very varied. In contact with the granite, they are "completely metamorphosed, passing regularly through the stages of a gneissose rock and mica-schist into clay- and grauwacke-schist." In the centre of the island they are chiefly mica-slate; near Peel they form a good roofing-slate; at Spanish Head they are so fibrous and tough as to be extensively quarried in lengths of six or eight feet for piles, door-posts, chimney-pieces, etc.; and about Douglas they become hard and splintery, and are much used for building purposes. In most of these rocks the cleavage is very imperfectly developed, and in others it does not appear at all.

These rocks are exceedingly rich in metals—copper, lead, silver, zinc, etc., being obtained. Several veins of lead and copper are profitably worked. The mines at Laxey, about halfway between Douglas and Ramsey, are especially noted. The vein runs nearly north and south, and "contains copper-ore, lead-ore rich in silver, varying from eighty to a hundred and twenty ounces in the ton of lead," and an ore of zinc, locally termed "Black Jack." To drain these mines a monster wheel, 72 feet 6 inches in diameter, stated to be the largest wheel of the kind in the world, is employed. Another mine, nearly equally important in its operations, is worked at Foxdale, near Peel. The lead obtained from this locality also contains a large amount of silver, though not nearly so much as is obtained from the Laxey ore. A third very extensive mine for copper and lead is worked on Brada Head, about one mile from Port Erin, in the S.W. of the island; and numerous other mines of greater or less importance have been in operation at different times. Many of these are now abandoned, but it is more from the lack of funds than from the exhaustion of the metals. This want of necessary funds has also prevented the opening of new veins of great richness which are known to exist. Whether the quartz-rocks associated with this series contain gold is a question of practical importance which we do not here pretend to solve. Having, however, a due regard to the generalizations of Sir Roderick Murchison respecting the gold-bearing rocks, and to the experience of the last few years in various parts of the world, especially in North Wales and other parts of the British Islands, it seems to us as not at all improbable that a careful search by practical men would be rewarded by the discovery of gold in remunerative quantities. Garnets, of a small size, are found at Greeba.

Resting upon the upturned edges of the older schists are found, on both sides of the island, some very interesting deposits of the Devonian period. Of the intervening Silurian beds but few traces now remain among the Manx rocks. Of their former existence, however, we have satisfactory proof in the fact that water-worn pebbles of Silurian age, containing characteristic fossils, enter largely into the composition of the overlying Old Red, particularly near Peel. The Devonian rocks lie unconformably upon the underlying Cambrian schists. At Langness, where this unconformability of the two series of rocks is beautifully exhibited, while their strike is almost identical, their dip is opposed—the schists dipping S.E. at a high angle, and the overlying Old Red dipping N.W. at an angle, in this place, almost equally high. They attain their greatest development to the north of the central ridge near Peel, being there several hundred feet thick,—principally of a workable sandstone. The venerable castle and a great part of the town of Peel are built of it; but it forms a very indifferent building material, being very soft, and decomposing rapidly by the action of the atmosphere. It is in the southern basin, however, near the ruins of Rushen Abbey, and along the west coast of Langness, that the rocks of this formation present their most interesting features, and where their relations to the underlying schists and the overlying limestone can be best observed. Proceeding along the western shore of Langness, the schists, here of a deep claret colour, are seen underlying the Old Red, and dipping inland (S.E.) at a high angle, much contorted; while the Old Red itself dips seaward (N.W.) at an angle equally high. The junction of the Old Red with the overlying limestone is not well developed in this locality, still by a little careful management it may be traced in the north-eastern corner of the bay, and the direction and intensity of their dip may be seen to be identical. The Old Red, as developed in this locality, is a coarse conglomerate of quartz and other pebbles, many of them of considerable size, enclosed in a red clayey matrix. It attains a considerable thickness, but, so far as my own observations extend, contains no fossils. It is possibly the equivalent of the conglomerate beds of the typical "Old Red" of Herefordshire, etc.

Further inland, near the ruins of Rushen Abbey, founded in 1134 by the Cistercian monks of Furness, we may trace the passage of the Devonian beds into the overlying Carboniferous limestone with greater accuracy. The conglomerate has here lost its characteristic red colour, and appears as a thin bed of very small white quartz pebbles in a limy matrix, enclosing the characteristic fossils, principally *Orthis Sharpei*, of the lowest Carboniferous rocks. About a mile higher up the Silverburn, near Athol Bridge, the passage of this grey conglomerate into the dark limestones and shales of the lower Carboniferous beds may be distinctly traced. The same appearances are also very clearly seen in ascending the Brough, a low hill overlooking the romantic valley of the Santonsburn, about two miles

N.E. of Castletown, where the Old Red is seen resting unconformably upon the slaty schists as a conglomerate of quartz and Silurian pebbles, enclosed first in a deep red clayey matrix, then in a grey calcareous one, and then passing conformably into the dark limestone above.

Resting conformably upon the Old Red conglomerate are the lower beds of the Carboniferous limestone, and with such regularity does the transition take place, that the characteristic fossils of the one formation are found mingled with those of the other. The Carboniferous limestone is now found only in the south of the island, but it formerly existed in the north, near Peel; and there is evidence of its continuance below low-water mark off the Peel coast.

In the south it covers an area of about twelve square miles, comprehending the whole of the S.E. corner of the island from Coshnahawin, near the mouth of the Santonsburn, round the coast to Perwick Bay, a little south of Port St. Mary, thence along a line of fault inland to Athol Bridge, and from Athol Bridge to Coshnahawin Head, with the exception of the southern extremity of Langness. Throughout the whole of this extensive area the limestone immediately underlies the superficial covering of Drift clay, etc., and in this locality, particularly along the coast from Coshnahawin Head to Port St. Mary, the phenomena of limestone deposits may be studied with great advantage.

The differences of composition, texture, and colour among the different limestone beds of this area are very great. Thus at Derbyhaven and Port St. Mary on the coast, and at Ballasalla in the interior, the limestone is very dark in colour, extremely hard, and makes a remarkably useful lime for agricultural and other purposes; while the limestone from Poolvash, in the centre of the basin, is very light coloured, rather soft, and is not equally convertible into lime. In other parts it is altered by the intrusion of Trap rock into a pure dolomite, as at Scarlet and Strandhall. In the N.E. corner of Castletown Bay it is of a brown arenaceous character, and highly crystallized in texture. A comparison of the fossil contents of these beds also indicates great differences in the physical conditions under which they were deposited. In the dark-coloured limestone of Derbyhaven, etc., organic remains are comparatively rare, while in the light-coloured they are, in most places, so numerous as to form fully two-thirds of the substance of the rock itself, and to give it its characteristic light colour. Out of a list of 222 species of Manx Carboniferous fossils published by Mr. Cumming, only 76 species are found in the lower or dark limestone, while 153 are found in the upper or light-coloured beds. Further, these two series of rocks "have comparatively few species in common, and those which are common are mostly such as have a great vertical range." Out of the 222 species collected by Mr. Cumming, only 30 or 7·4 of the whole are common to the two series of rocks. Hence Mr. Cumming, when investigating these beds in 1848, was led to divide the lower member of the Manx Carboniferous rocks into two groups—the upper or light-coloured limestone of Poolvash, and the lower or dark-coloured limestone of Derbyhaven, etc. The list of the Manx Carboniferous fossils upon which this subdivision of the Manx limestone into two groups is principally based, is of course very far from being complete; we have in our own collection several not included in it, and undoubtedly a more careful search would disclose many more; while several designated in it as species have since been reduced to the condition of mere varieties. Yet, on the whole, it is a trustworthy record, and the minute observations accompanying it are carefully made and generally accurate; we feel, therefore, no difficulty in accepting this proposed division of the lower portion of the Manx Carboniferous limestone into at least two distinct groups.

Subsequent to the deposition of the Poolvash beds a great change seems to have taken place in the physical condition of this part of the southern basin. The strata were violently disturbed along a line of fault parallel, or nearly so, with the present coast-line, and a considerable outburst of trap took place, which has greatly altered the underlying limestone, in some places converting it into pure dolomite. The extreme violence of this outburst, however, seems to have soon abated, after which the volcanic ash was poured out so quietly as not to interfere to any great extent with the ordinary operations of organic life—organic remains being found imbedded in it as regularly as in the limestone. At the same time that this submarine eruption was thus forming in one part of the basin a thick bed of volcanic ash, a deposit of black carbonaceous mud was also being formed in another part, and these two dissimilar sources by mingling have formed a very curious and interesting rock, one or other of the two ingredients predominating according to the varying circumstances of the case. "At one period the carbonaceous deposit seems to have entirely prevailed; perhaps the volcanic action entirely ceased, gathering strength for a subsequent eruption. The bed then formed has its own lithological character and fossils; it is the black Poolvash marble." After a time, however, this period of quiet deposit was abruptly terminated, and the volcanic action renewed with increased violence; the trappean and mixed beds already formed were violently broken up, reduced to a fragmentary condition, and mixed up with a fresh outpouring of volcanic matter; and a sort of "trap breccia" was formed, in which the imbedded fragments of the older rocks are considerably altered by heat.

Such is a brief and very imperfect account, agreeing mainly with Mr. Cumming's, of a remarkably interesting series of rocks overlying the Manx Carboniferous limestone. Commencing near the Stack of Scarlet, a huge mass of columnar basalt, insulated at high water and forming the S.W. horn of Castletown Bay, stretching along the south coast to Poolvash Bay, a distance of about two miles, they include, in addition to the imbedded limestone of pure or mixed origin, almost every variety of igneous trap, from the light porous ash to the hard columnar basalt, and present an appearance wild and rugged beyond description.

The strike of the underlying limestone is nearly due north and south, and the dip is to the west, at a generally low angle. In some places the tuff underlies the "black marble," sometimes it overlies it: in some places again they are interstratified, while in others they form beds of a mixed character. In all, the characteristic fossils are found. The black marble is remarkable as containing the only traces of coal-plants found on the island, several species of ferns, calamites, and lepidodendra having been found in it. This marble admits of a high polish, and is extensively quarried for architectural and other purposes. Here the palæozoic series of the Isle of Man terminates. From these rocks, evidently belonging to the lower beds of the coal-measures, to the clays and gravels of the Pleistocene group, there is a great gap, which we have little hope of ever being able to fill; either the intervening deposits have never had an existence here, which is the more probable, or else they have been completely denuded and no trace of them now remains. Of the history of this vast period we are not, however, altogether ignorant, several of the numerous faults and dykes found in different parts clearly belonging to it; and we are thus, by tracing their effects, able to gather a few meagre particulars respecting the nature of operations which would otherwise have escaped all notice.

Crossing these tufaceous beds and parallel to them are trap dykes, which in their passage through them and the subjacent limestone have greatly dislocated and contorted the strata. The interesting question thus arises, what effect, if any, these igneous intrusions had upon these beds? Again, in the north of the peninsula of Langness there is an enormous development of greenstone, and the peninsula is crossed in all directions by numerous greenstone dykes, one of them more than forty feet broad, where it emerges from under the schists. The peninsula itself is a mass of Cambrian schists, once undoubtedly covered by Devonian and Carboniferous deposits, but of which its central and eastern parts are now completely denuded. What connection was there between these igneous intrusions and the elevation of the peninsula, one consequence of which was the denudation of these later beds? But leaving these and many other similar speculations respecting the possible or probable effects of the numerous faults and dykes which cross many parts of the island like network, we come to notice more particularly a great line of fault which has undoubtedly played a conspicuous part in the later geological history of the island. This great fault extends from Perwick Bay, half a mile south of Port St. Mary, in a north-eastwardly direction, through Port St. Mary, Strandhall, and Athol Bridge, and cuts off abruptly all the Devonian and Carboniferous rocks. To the north-west of this line are the Cambrian schists, dipping, at an angle of varying intensity, to the south. To the south-east of it are the lower beds of the Carboniferous limestone, dipping, at a very low angle, to the east. The uplift is consequently to the north-west of this line. Its value cannot, with the scanty facts respecting it in our possession, be accurately estimated; but it must have been very great, as it includes the whole of the Manx Carboniferous series, the Devonian conglomerate, and a considerable portion of the underlying schists. Subsequent to the production of this great fault, in whatever portion of the missing series it took place, a great denuding force passed over the island, sweeping away the whole of the uplifted rocks to the north of the fault, and reducing both its sides to the same uniform level. Of this long-continued period of denudation, we have additional evidence in various other parts of the island; on Langness, in the neighbourhood of Coshnahawin Head, etc., and particularly in the neighbourhood of Douglas Bay, where we have developed the uppermost beds of the clay-schists, containing fossils which identify them with equivalent strata in other localities; these show distinctly marks of very extensive denudation. It is highly probable that the granite on the east side of Barrule was laid bare at that epoch, granitic pebbles appearing for the first time, so far as is known, in the Pleistocene gravels. That this denudation took place *before* the deposition of the Pleistocene beds, we have the most distinct proof in these beds resting in an undisturbed position along the line of the great fault.

The superficial deposits of the Isle of Man are, in many respects, peculiarly well developed, and at the present time are remarkably interesting. We have first a very thick deposit of boulder-clay, containing numerous boulders of quartz, etc., occasionally of large size; this is succeeded by alternating beds of sand and gravel, enclosing enormous boulders of both native and foreign extraction. Connected with these beds are two series of remarkable low hills, one in the south of the island extending from the mouth of the Santon's Burn, in a south-west direction, towards the mountain-range, and the other, northerly, stretching "from Point Cranstal to Blue Head." Their general direction is almost parallel to the central range, and also to the direction of the glacial currents, as exhibited by the groovings and scratchings in the underlying rocks. They consist of the clay, sand, and gravel of the Boulder formation, in the usual order: first, the clay of the colour of the underlying rocks, and containing fragments of them partially rounded; then sandy gravel, much of which is of foreign origin; and lastly, the Drift gravel, often enclosing large boulders of limestone, granite, etc. This order is well developed in the banks of the Silverburn, near the Creggans. Mount Strange, or Hango Hill, as it is more commonly called, at the head of Castletown Bay, is another interesting relic of the Boulder-clay formation. It rises about twenty feet above high-water, and consists of the Drift-clay enclosing numerous boulders of limestone, granite, quartz, etc., many of large size. I measured one, of dark-coloured limestone, probably from Derbyhaven, and found it almost three feet across each way. I also obtained from the clay at this spot, a number of shells of the Boreal type, mostly in good preservation. This cliff is crowned with the ruins of the old place of execution, three fragments of the walls of which still remain, built of limestone, about a foot and a half thick. It is rapidly wasting away, and at the present rate a few years will witness its complete destruction. Some very interesting historical associations are connected with this spot, and the readers of Scott will regard it with increased interest when they remember that William Christian, of Ronaldsmay, was shot here in 1662, for surrendering the island to Cromwell's army.

To this period also belong the numerous natural arches and caves found along the coast; probably, however, most of them belong mainly to the later portion of the Pleistocene age. They are found on all parts of the island, wherever the nature of the coast-line was favourable to their formation. Many of them run considerable distances into the cliffs, frequently winding tortuously; in other instances they are merely deep straight chambers in the rocks. They are usually but little elevated above the existing high-water mark, and appear to contain only the ordinary shingle and sand of the neighbouring shore. The most remarkable of these arches and caves are those on the western side of Langness. The rocks there are greatly dislocated by the intrusion of several greenstone dykes, two of which intersect at this spot, and the strata thus weakened have yielded to the action of the waves, an extensive series of arches and caves having been the result. One of the most remarkable of these is an arch about twenty-six feet wide, fifteen feet high, and eighteen feet deep. The floor and walls are composed of slaty schists, here of a deep claret-colour, thrown up at a high angle, and much contorted by the neighbouring greenstone; the roof is formed of the Old Red conglomerate, which is of the characteristic deep red colour, and rests almost horizontally upon the edges of the upturned schists. This arch stands a few feet above high-water mark, but it is evidently only the relics of what was once a vast cavern, extending far below the level of the sea. Its sides (the lower portion consisting of the contorted schists, and the upper of the coarse conglomerate) extend seaward from thirty to forty yards beyond the arch itself, a great part of this being below high-water, and the partially enclosed space much encumbered with huge masses of fallen conglomerate, evidently the débris of the broken roof. Several others of the series equal, if they do not even exceed, this one in magnitude. One in particular, roughly measured by pacing, in its entire state would have been a cave fully sixty yards deep,—twenty yards of its depth being below high-water,—ten yards wide, and, at its upper end, eight yards high. At its upper extremity it is still covered with a roof for about twenty-five feet, and its walls are there nearly thirty feet high, sloping thence down to the water. These caves and arches present many features of great interest, and are deserving of a fuller investigation. The occurrence also in this locality of the Cambrian schists, the Devonian conglomerate, and the Carboniferous limestone, in their characteristic positions, together with the numerous greenstone dykes, make Langness, to the geologist, one of the most interesting spots to be found in the whole island; while the wild and rocky nature of its coast, and the many picturesque views to be obtained from it of the beautiful bay and neighbourhood of Castletown, cause it to be a favourite place of resort for both natives and visitors.

Another excellent locality for the study of these arches and caves, is the coast about the mouth of the Santon's Burn, two miles N.E. of Castletown. As at Langness, the strata are much disturbed by the intrusions of greenstone, and, in consequence, several magnificent arches and a number of moderately-sized caves have been hollowed out in the rocks. Some interesting specimens may also be found at Port Soderic, a small inlet of great beauty about four miles south of Douglas; at Spanish Head and the Calf, where are some splendid grottos, and where the remarkable one called the "Eye" deserves particular notice; also at Peel, where many small but interesting caves have been scooped out of the Old Red conglomerate.

The organic remains found in these deposits are of the usual character. In the Boulder-clay, fragments of the bones of cetaceans, etc., have been found; and in the clays and sands, shells belonging to existing species are found in great abundance, "the most frequent species being *Tellina solidula*, *Venus cassina*, *Astarte Scotica*, and *Turritella terebra*."

The phenomena of the Drift period may be well studied in the great valley which crosses the middle of the island, between Douglas and Peel, and in most of the side-valleys communicating with it, particularly Spring valley and the valley of West Baldwin; also in the flat districts of the north, and in many of the valleys of the south. In some of these localities, and especially in various parts of the great central valley, the successive elevations of the post-glacial sea-bottom may be very distinctly traced, until, in very recent times, it assumed its present level. In very recent times, geologically, the sea entered this valley at both its extremities, and it was drained finally by an alteration of the sea-level, which was probably the last that affected to any great extent the physical condition of the island; an event which seems to have taken place within the traditional age, if the name of the former residence of the Duke of Athol—Port-e-chee, the haven of peace—or the assertion of the inhabitants of Douglas, that the land is even now gaining upon the sea, may be received as evidence. On the low alluvial land laid bare at the mouth of the Douglas by this latest alteration of sea-level, the old town of Douglas is built, and the inhabitants state that within memory the sea has retired a considerable distance, and that houses which, when built, were close to high-water mark, are now at some distance from it. So small was this uprise, and so inconsiderable is the elevation of this valley above the existing sea-level, that a very slight depression of the land would again cover it with the waters of the sea, and again divide the island into two or more portions. This valley is drained on its eastern declivity by the Douglas, and on its western by the Neb, both of which rise close beside each other near St. John's, and so inconsiderable is the height of their sources, that the cutting away of a foot or two of turf in this spot, would cause the Neb to flow eastward to Douglas, or make the Douglas flow westward to Peel.

In connection with these oscillations of sea-level, we may also notice the fact, that in the south of the island, near Strandhall, between high- and low-water, is a bed of turf "about a foot thick, with the trunks of trees, chiefly ash and fir, standing upright, and their roots running down into the alluvial blue sandy marl. These roots may be traced for several feet, and it is plain that 'here they lived and died.'" Mr. Cumming states, in 1848, that he has in his possession one of these tree-stumps, *bearing upon it* "*marks of a hatchet;*" and he further records, on what he considers unquestionable testimony, that during a violent storm in 1827, the sands at a spot a little to the west of Strandhall were swept away, and a vast number of trunks, some erect and others overthrown towards the sea, were exposed, and that "*the foundations of a primitive hut*" *were laid bare, together with some* "*antique, uncouth-looking instruments.*" These facts, taken in connection with the traditions respecting the presence of the sea at Port-e-chee, are of the highest importance in their bearings upon the great question of the antiquity of the human race, and would, if properly authenticated, establish the fact of great physical changes having passed over the island during the human epoch. The subject is certainly deserving of further investigation.

Additional evidence of these successive uprises of the land exists at different parts of the coast in the shape of ancient beaches and beds of gravel at various elevations. Good examples of both may be found in the neighbourhood of Douglas. The old town itself is built upon the last-raised beach, and in digging for building or other purposes, a considerable thickness of fine sand is passed through, identical with that now found on the adjacent shore, and often containing fragments of bones much decomposed. Behind this most recent of the raised beaches there rises to a considerable height all round the bay a much more ancient one, in some places consisting of the underlying slaty schists, and in others—near Castle Mona, for instance—of thick beds of fine sand, similar to that composing the present beach.

In the interior and in the north of the island, particularly at St. John's, between Douglas and Peel, and at Ballaugh, between Peel and Ramsey, are extensive marl-beds, in which fragments, and occasionally whole skeletons, of the great Irish—or rather Manx elk, as it is asserted that the first specimen of this gigantic animal was discovered here, and not in Ireland—are found. The most perfect specimen known was found in a marl-pit at Ballaugh, in 1819, at a depth of eighteen feet, and was presented by the Duke of Athol to the University of Edinburgh; a magnificent head and horns from the same place is now in the British Museum. These marls are full of fresh-water shells of existing species, and occasionally become a true shell-marl.

Resting upon these marls, and filling up the hollows of most of the upland valleys, are extensive peat-bogs of great thickness. They contain great quantities of trunks of trees, principally pines and oaks, proving the fact—of which, indeed, we have frequent notice in Manx history—of the woody character of the island in former times. This peat, owing to the want of coal in the island, is of great value, and is very extensively used by the natives as fuel.

Near Spanish Head the rocks are rent by twelve perpendicular fissures of unknown depth, opening out towards the sea, and dividing the headland into huge pyramidal and conical masses, "which overhang the shore," and seem ready on the slightest disturbance to fall headlong into the waves beneath. "In one of these recesses, which penetrates many hundred yards into the solid rock, is a circle of erect stones, appearing to have been a Druidical temple, for which, from the solitude and sublimity of the situation, no place could be more appropriate." These "chasms" are probably the effects of an earthquake in very early times.

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

Geological Society of London.—*March* 19.—The Papers were

1. "On the Sandstones, and their associated deposits, in the Valley of the Eden, the Cumberland Plain, and the South-east of Dumfriesshire." By Prof. R. Harkness, F.R.S., F.G.S. Having defined the area occupied by these sandstones, breccias, clays, and flagstones, and referred to the published memoirs in which some notices of these deposits have been given by Buckland, Sedgwick, Phillips, and Binney, the author described, 1st, a section near Kirkby-Stephen, across the vale of the Eden, where two breccias, separated by sandy clay-beds, underlie sandstones of considerable thickness; 2ndly, a section across Eden Vale from Great Ormside to Roman Fell, in which the breccias, associated with sandstones, form a mass 2000 feet thick, and are succeeded by thin sandstones, shales (with fossils), and thin limestone, altogether about 160 feet, and next by sandstones 700 feet thick. This is the typical section; the fossiliferous shales are regarded by Prof. Harkness as equivalent to the Permian Marl-slate of Durham; they contain (at Hilton Beck) remains of *Coniferæ*, *Neuropteris*, *Sphenopteris*, *Weissites* (?), *Caulerpites selaginoides* (?), *Cupressites Ullmani* (?), *Voltzia Phillipsii* (?), *Cyathocrinus ramosus*, and *Terebratula elongata*. The breccias and sandstone beneath, previously recognized as Permian, are here referred to the Rothliegende; and the sandstones above are regarded as belonging to the Trias. Detailed descriptions of the sandstones and breccias in the country between Great Ormside and Penrith were then given, and the gypseous character of the clays at Long Martin and Townsend noticed. In the section across the vale of the Eden from the west of Penrith to Hartside Fell, the Permian breccias, sandstone, and flags are nearly 5000 feet thick, but the clay series is poorly represented. North of Penrith the flagstones bear foot-marks (at Brownrigg) like those of Corncockle Muir. Mr. Harkness next described several sections of these Permian rocks in the western Westmoreland; and traced them to the other side of the Solway Forth, in Dumfriesshire (as described in former papers). Some remarks on the relations of the Permian beds of Cumberland and Westmoreland with those of St. Bee's Head, near Whitehaven, and those of Annandale and Nithdale, concluded the paper.

2. "On the Date of the Last Elevation of the Central Valley of Scotland." By Archibald Geikie, F.R.S.E., F.G.S. After alluding to the position and nature of the raised beach which, at the height of from 20 to 30 feet above the present high-water-mark, fringes the coast-line of

Scotland, the author proceeded to describe the works of art which had been found in it. From their occurrence in beds of elevated silt and sand, containing layers of marine shells, it was evident that the change of level had been effected since the commencement of the human period. The character of the remains likewise proved that the elevation could not be assigned to so ancient a time as the Stone Period of the archæologist. The canoes which had from time to time been exhumed from the upraised deposits of the Clyde at Glasgow clearly showed that at the time when at least the more finished of them were in use, the natives of this part of Scotland were acquainted with the use of bronze, if not of iron. The remains found in the corresponding beds of the Forth estuary likewise indicated that there had been an upheaval long after the earlier races had settled in the country, and that the movement was subsequent to the employment of iron. From the Firth of Tay similar evidence was adduced to indicate an upheaval possibly as recent as the time of the Roman occupation. The author then cited several antiquaries who, from a consideration of the present position of the Roman remains in Scotland, had inferred a considerable change in the aspect of the coast-line since the earlier centuries of the Christian era. He pointed out also several circumstances in relation to these Roman relics, which tended to show a change of level, and he referred to the discovery of Roman pottery in a point of the raised beach at Leith. The conclusion to which the evidence led him was, that since the first century of our era the central parts of Scotland, from the Clyde to the Forth and the Tay, had risen to a height of from 20 to 25 feet above their present level.

April 2, 1862.—The following communications were read:—

1. "On some Remains of *Chiton* from the Mountain-limestone of Yorkshire." By J. W. Kirkby, Esq.

These remains consist of eight separate plates of four species of *Chiton*, found by Mr. Burrow, of Settle, in the Lower Scar Limestone of that neighbourhood. These new species, determined by Mr. Kirkby, are *Chiton Burrowianus*, Kirkby, *Ch. coloratus*, Kirkby, two species undetermined, and a trace of *Chitonellus* (?). These appear to be the first Chitons observed in the Carboniferous limestone of England; but fourteen others, and a *Chitonellus*, have been found in strata of the same age in Belgium and elsewhere, and have been described by Münster, De Koninck, and De Ryckholt.

2. "On some Fossil *Reptilia*, of the Order *Ganocephala*, from the Coal-measures of the South Joggins, Nova Scotia." By Professor Owen, F.R.S., F.G.S.

The specimens described in this communication were (together with remains of *Xylobius* and *Pupa*) obtained by Dr. Dawson, F.G.S., in 1861, from two fossil stumps of trees, and were referred to in his communication read before the Society on November 6, 1861. Professor Owen has determined among the specimens submitted to him the following small Reptilian forms—*Hylonomus Lyelli*, Dawson, *H. aciedentatus*, Dawson, *H. Wymani*, Dawson, *Hylerpeton Dawsoni* (nov. gen. et sp.), Owen, and *Dendrerpeton Acadianum*, Owen.

3. "On the Occurrence of Mesozoic and Permian Faunæ in Eastern Australia." By the Rev. W. B. Clarke, F.G.S.

Mr. W. P. Gordon having been requested by the Rev. W. B. Clarke to search for fossils in his neighbourhood (between the Balonne and Maranoa Rivers) and in the Fitzroy Downs, Queensland, was successful in making a large collection of specimens at the Wollumbilla Creek. These he sent to Mr. Clarke, who forwarded them to Professor M'Coy, at Melbourne, for his examination. They prove to be chiefly of Lower Mesozoic genera; there are also a few (from the Fitzroy Downs, about thirteen miles to the N.W.) which belong to lower beds. Some fossils long since obtained from the Mantuan Downs (200 miles N. of Wollumbilla) prove to be of Permian character (*Aulosteges* or *Strophalosia*). *Productus* and *Cyathocrinus* (Carboniferous?) have been met with on the Dawson River.

Mr. Clarke considers his unfossiliferous Wianamatta Beds, above the coal-measures, near Sydney, as being probably the equivalent of the fossiliferous strata at Wollumbilla Creek. Professor M'Coy regards the latter as belonging to the same formation as the coal-beds with *Glossopteris*. The fossils are included in the Catalogue of the Products of New South Wales for exhibition in London in 1862.

4. "On the Footprint of an *Iguanodon*, lately found at Hastings." By A. Tylor, Esq., F.G.S.

After alluding to former accounts of fossil footprints (and natural casts of footprints) found in the cliffs near Hastings, and having stated that Dr. Harwood in 1846 suspected these prints to have been due to the *Iguanodon*, the author described a large three-toed footprint, 21 inches long, by $9\frac{1}{2}$ in width, lately exposed by a fall at East Cliff. A cast of this print was exhibited by Mr. C. J. Mann. Mr. Tylor alluded to Professor Owen's figure of the bones of the three-toed foot of an *Iguanodon* as illustrative of a foot capable of producing such imprints as those referred to. The author then showed, by a newly-constructed section of the Hastings coast, that the footprints occur in at least two zones of the Wealden beds,—one of them being just above the chief sandstone (or Castle Sandrock) of Hastings, and dipping down to the west on the top of the Bexhill cliffs; the other zone being about 100 feet below, as already pointed out by Mr. Beckles, near Lee Ness.

Mechanics' Institute, Richmond, Yorkshire.—1*st April*.—Mr. Edward Wood, F.G.S., the president of the Institute, delivered a lecture in the Town Hall on "Coal, Coalpits, and Pitmen," to a densely crowded audience. The lecture had been originally announced for the benefit only of the members of the institute, and to be given in their own room, but at the solicitation of the Mayor, Mr. Wood consented to deliver it in the Town Hall, for the benefit of all, whether members or not. The Mayor (Mr. G. Smurthwaite, jun.) took the chair.

Mr. Wood commenced by a short but very telling description of the state of the globe prior to the time when the Carboniferous series was deposited, in the upper part of which the coal-measures are placed. These were then described, and the geographical conditions of the British region in the Coal-era. "Our coal-fields," said the lecturer, "are so circumscribed that, if the consumption of coal goes on increasing in the same ratio that it has been doing of late, namely, doubling itself in twenty years, we shall exhaust all the workable coal in the British Isles in less than five hundred years hence. This was a most important consideration, for how much of our country's greatness did we not owe to coal? Besides our machinery (all driven by coal), we derived heat and light from it. And from coal also, our chemists, especially Professor Hoffman and Mr. Perkin, have lately learned to derive new and beautiful dyes—mauve, magenta, solferino, and others. Gas-tar was, till within a few years ago, considered worse than useless—to touch it was to be defiled; but our chemists now extracted the sweetest of perfumes and the most elegant of colours, which, after being concealed in the earth's recesses for countless ages past, are now brought out bright enough to gladden the hearts of the cardinals at Rome, important enough to have materially influenced the fashion-leaders of the day, and brilliant enough to give a lustre even to the cheek of beauty." With the assistance of a ground-plan of colliery workings, Mr. Wood explained the wonders of a pit, with its upcast shaft, its downcast shaft, its furnaces, engines, its cages and its levels, the wonderful and yet simple history of its ventilation, the mode of winning the coal, the colliers as they worked. It is the habit too much, the lecturer said, to blame colliery proprietors for carelessness. He believed that great and vigilant care was used, if not alone from the sense of right and duty yet at all events from the fear of accidents, which were destructive to property in a manner ruinous in the extreme. Legislative interference was, he believed, too much and somewhat ignorantly asked for. Our colliery population Mr. Wood estimated at 1,500,000, of whom 400,000 were men and boys actually employed in the pits. Mr. Wood described most feelingly and eloquently the daring and endurance of the men who, day after day, worked purely from the love for their fellow-men, to rescue their poor comrades at the late accident at Hartley. He then detailed with most engaging particularity the objects to be seen within the collier's cottage, throughout which there was marvellous, almost painful, neatness and cleanliness. The collier's wife never thinks of reducing her fire; her room is always at a roasting temperature; and when at last nature can no longer stand it, she opens the door, and this constantly, be it winter or summer. Mr. Wood concluded his lecture with some very amusing anecdotes.

Manchester Geological Society.—*February* 25.—The propriety of forming a local fund for the relief of widows dependent upon coal-miners killed or hurt, was the subject of some discussion. The papers read were:—1. "On Mr. Aytoun's Patent Safety Cage for Miners." By Mr. J. J. Landale, Mining Engineer, Edinburgh. 2. "On the Gases met with in Coal-Mines, and the General Principles of Ventilation." By J. J. Atkinson, Esq., H. M. Inspector of Mines for the South Durham district.

Liverpool Geological Society.—*March* 24*th*.—The president, Henry Duckworth, F.L.S., F.G.S., read a paper "On Flint Implements from the Drift; being a description of a visit to Amiens and Abbeville during the summer of 1861."

Mr. Duckworth did not discover any worked flints himself, but he exhibited several very characteristic specimens, some of them being obtained from the quarrymen, and others presented to him by Monsieur Boucher de Perthes and Monsieur Pinsard. Mr. Duckworth also exhibited a human skull, which he disinterred from the brick-earth bed, in what was stated to be a somewhat unusual position. The paper was illustrated by drawings of sections, etc. In conclusion, Mr. Duckworth remarked that in examining these Drift beds both at Amiens and Abbeville, but more especially at the former place, it seemed to him that they must have been deposited very rapidly. There is no evidence whatever, so far as he could judge, of any very slow or gradual formation; and the impression left upon his mind was that they have been produced by some sharp and sudden catastrophe.

"On the Strata of the Storeton Quarries, near Liverpool." By G. H. Morton, F.G.S.

After referring to the Keuper formation as it occurs near the town of Liverpool, the strata of Storeton (in Cheshire) were described as belonging to the lower part of that formation. The base is a conglomerate, several feet thick; strata of white and yellow sandstone with several beds of shale and marl succeed, the thickness altogether being about 200 feet. About 130 feet from the base of the formation there is a bed or band of sandstone, three feet thick, with two or three seams of marl, and many ripple-marked surfaces. It is only in this limited band that footprints of the *Cheirotherium* and four other much smaller reptilian impressions have been found; the only other trace of a fossil that has been discovered being the remains of an Equisetiform reed at Flaybrick, a neighbouring locality in similar strata. Higher beds of the Keuper sandstone occur towards the east of Liverpool, where thick strata of grey and red shales, with yellow and red sandstones, form the uppermost part of the Keuper on the Lancashire side of the Mersey. In Cheshire the overlying "Red Marl" can be seen reposing upon still higher strata, about Greasby and other villages in Wirral. The thickness of the whole of the Keuper formation near Liverpool is probably about 550 feet.

GLASGOW GEOLOGICAL SOCIETY.—11*th April.*—About thirty of the members of the Glasgow Geological Society proceeded on their first excursion of the season. The ground examined extends between Bowling and the river Leven. The heights above Auchentorlie House were found to be trappean; a considerable platform of white sandstone in one spot, little affected by the surrounding igneous rocks, has been quarried for building purposes. Where the sandstone is contiguous to the trap, it is much altered. The excursionists next struck off in a north-westerly direction, skirting the bold escarpment of the "Lang Craig;" crossing the eastern branch of the Garshake Burn, they discovered a trap-dyke intersecting and exposing a seam of the peculiar thin-bedded grey limestone of the "Ballagan" series of strata, evidently underlying the thick-bedded sandstone of the higher level. A short walk brought the party to Garshake Burn. Here a highly interesting section of shale, sandstone, and limestone, appears for a considerable distance along the banks of the stream. Then the party proceeded to Auchenreoch Glen, still further west. This glen divides into two branches, the stream which threads it flowing into the Leven above Dumbarton, and the beautiful sections of strata exposed in its banks have long attracted the attention of geologists.

The "Gates of Sodom," a vertical dyke of greenstone-porphyry crossing the course of the stream, which flows through a breach in this natural barrier, was an object of remark, as was also a grotesque column of tufaceous felstone, locally known as "Lot's Wife." Other trap-dykes were found intersecting and disturbing the strata, and in the lower part of the glen a seam of fibrous gypsum was discovered in the shale.

The course of the stream was then followed to the low ground, where the underlying Old Red sandstone was expected to appear, but the junction could not be observed on account of the superincumbent drift. Some of the members now parted for Dumbarton, but some continued towards Bowling, and after viewing the junction of the Old Red with the "Ballagan beds" in Dumbuck Glen, and visiting Dumbuck, finished with groping by moonlight for zeolitic minerals in Bowling quarry,—not without success.

GEOLOGISTS' ASSOCIATION.—*April* 7, 1862.—Mr. Cresy read a paper "On some ancient skulls and flint-implements found in the Essex marshes during the progress of the Northern Outfall Sewer of the Metropolitan Main Drainage Works."

The three skulls exhibited were found along the line of the sewer, one on the east, and another on the west side of the River Lea, and the third, to which the greatest interest attached, in the East Ham marshes. A diagram was exhibited showing sections of the strata at various points.

From one to two feet of surface soil, chiefly vegetable mould, was first penetrated, then a bed of yellow or brown clay, three to five feet, then blue clay, two to four feet,—this sometimes alternated with beds of peat, —and then the gravel was reached. No shells of any kind have yet been found, nor is there any other evidence by which the age of the several deposits can be determined.

The author did not assign the highest antiquity to any of the skulls exhibited, as the flint-tools found near them were not of the earliest or drift type; these (exhibited) were both polished and chipped.

Previously to describing the skulls, the author enumerated the most marked characteristics of the Orcadian, Scandinavian, Ancient British, Roman, and Saxon skulls, comparing the one with the other, at the same time admitting the difficulty of an absolute classification, and pointing out the wide differences existing among individuals of the same race. Still, the causes of modification being fewer and less active amongst ancient than amongst modern races, it was easier to arrive at more certainty of determination in ancient skulls than of those of our present mixed races.

The author pointed out that the three skulls exhibited separate and well-marked types. That from the west side of the river Lea was comparatively small and well-proportioned, and apparently of a young person.

The second, from the east of the river Lea, was of large size, with immense posterior development, and was evidently that of a man past middle life. The large bony crest of the occipital bone was extremely marked by the former attachment of large and powerful muscles. Altogether this skull showed great animal development and had marked affinities with many of the skulls of the Celtic period.

The third skull, from East Ham marshes, presented the greatest interest; in its vicinity were found the two flint-implements, and it was probably the earliest of the three. The frontal development was very low, the vertical aspect narrowing rapidly anteriorly, the occipital region predominating considerably over the frontal; the bony ridge of the occiput, too, was very marked; the sutures were nearly obliterated, so it was an aged skull. The author compared it with a cast of the Engis skull, and believed there were points of resemblance.

Professor Busk, F.R.S., gave elaborate descriptions of the peculiarities of the skull.

Mr. C. C. Blake pointed out the discrepancies between the observations of those craniologists who had assigned particular crania to particular periods, as *e.g.* between Steenstrup and Wilson, the former having, by his observations in Scandinavia, correlated the brachycephalic skulls with the date of the earliest known stone deposits in Denmark, whilst Wilson had demonstrated the existence of a long-headed (kumbecephalic) race of men from cairns at Nether Urquhart in Fifeshire and elsewhere, prior to the brachycephalic races who have left their remains in the later Stone period at Montrose. He hoped that some solution might be offered for this apparent discrepancy.

Mr. S. J. Mackie, F.G.S., remarked that the geological conditions in the present case seemed to have been somewhat overlooked. The sections in some places exhibited three beds of peat, and these ought to be carefully examined to see whether any vegetation existed in this country at the periods of their formation different from that which is now indigenous.

He did not think attention should be solely given to the form and other craniological characters of the exhumed skulls, for craniologists seemed to be by no means certain of the distinctions they had drawn being typical. He thought it rather rested with geologists to prove by *stratigraphical* evidence the *antiquity* of such remains, and thus furnish a stable basis for the inferences of the craniologist and ethnologist.

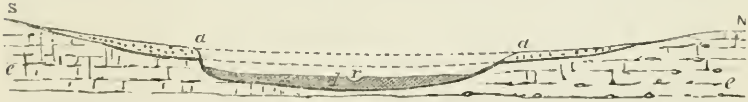
The following diagram will show the relative positions of the human remains and the flint implements: the sections being those given by the wells sunk for the drainage works; the distance between them is 350 feet:—

No.	Section No. 60.	ft.	in.		ft.	in.	Section No. 61.	No.
1.	Surface Soil . .	1	3	. . . .	1	3	Surface Soil . . .	1.
2.	Brown Clay . .	1	9		4	6	Soft light-brown Clay	2.
	Soft blue Clay . .	4	0					
	Peat	1	0					
	Soft blue Clay . .	3	0					
	Peat	1	0					
	Soft blue Clay . .	2	0		10	9	Soft blue Clay . .	
	Peat	2	9					
				* Skull. † Celts † With bones of whale, deer, ox, etc., at 15 ft. from the surface.				
3.	Gravel (sunk into)	4	0		4	0	Gravel (sunk into) .	3.

The surface of the marsh-land at East Ham is 5 feet above Ordnance datum (Liverpool mean-tide), or $12\frac{1}{2}$ feet above Trinity high-water mark. Consequently the level at which these relics were found, is one foot below low water spring-tide of the district.

Such remains might be of like age with the relics of the Scandinavian Stone period or of the Swiss Lakes. They might be within the historic date. Nothing could prove this point but the strata themselves. It was not a little singular that on the opposite side of the river to the East Ham marshes there were thick layers of cockle-shells beneath the soil in many places. One of these, perhaps the most easy to find, occurred near Lesnes Abbey, and a small section of it was exposed at the side of the road leading towards the river. He did not mean to say that this was actually a refuse-heap, like the Kjökkenmöddings, but he thought such accumulations were worth examining.

Royal Society.—*March* 27.—"Theoretical Considerations on the Conditions under which Drift Deposits containing the Remains of Extinct Mammalia and Flint Implements were accumulated, and on their Geological Time." By Joseph Prestwich, Esq. In the paper which the author read before the Society in 1859, it was demonstrated that the flint implements occurred in undisturbed gravels commingled with the remains of extinct mammalia; but the theoretical considerations of the subject were then omitted. The author now showed that in existing river-valleys, in



Section in the Valley of the Seine. *a a*, high-level gravels; *d*, valley gravels; *r*, present river-course; *e e*, chalk-rock *in situ*.

parts of England and France, two lines or zones of gravels or drift deposits are met with; one at from fifty to two hundred feet above the present streams, and usually forming a terrace: the other ranging along the bottom of the valleys. The elevated terraces are portions of former valleys, wider and more shallow than the present ones, scooped out by other and different causes than mere ordinary river-action. They are above the reach of the highest floods, and no other mass of water than that flowing up an arm of the sea could fill them. The Seine, at its highest flood, has not exceeded twenty-nine feet, but it would require the present rivers to be of a hundred times that volume to fill the existing valley. That the terraces were originally connected is proved by the isolated patches of their gravels still lying at elevated spots between them. The author believed that the gravels were brought and distributed by ice and by the melting of the winter snows in spring pouring down great bodies of water, the gravels enclosing boulders of hard rock, brought often from long distances. He also attributed much importance to the action of ground ice. He pointed out contortions in the drift-bed at St. Acheul, as formed by the pressure and squeezing force of massive ice. The characters of the gravels were then considered, in reference to the climatal condition of the drift period, which the author argued were those of a more intense cold, by 20° or 25°, than the average of our present winters. The bearings of the geographical distribution of the animals of that period, and its comparison with those of existing forms of life, were also assumed to confirm this inference. The use assigned for some of the largest flint implements was that of making holes in the ice,—the men of the drift-age, like the North-American Indians and the Esquimaux, being very often dependent upon winter supplies of fish. Since the formation of the high-level gravels, an elevation of the land has taken place, and the present valleys excavated, and the lower gravels deposited. The tendency of existing rivers was to cut deep gorges, and not valleys, with sloping sides, such as those containing the gravels. The large flint implements were nowhere so abundant in the valleys as in the terrace-gravels. Flint-flakes, on the contrary, were most common in the valley-gravels,—the climate of the valley-period being more lenient, there was a diminished need of great flint chisels for breaking the ice. These distributions, at two periods, of different forms of implements indicated a difference in the habits of the tribes by whom they were respectively used.

In the questions of time and succession the value of probabilities must be considered. The antiquity of the flints was carried back through three geological ages,—the loëss, terrace, and valley-gravels; all long periods except the loëss, the duration of which was comparatively short. The sand-pipes in the valley of the Somme were first considered as a standard of time-measurement; and then the author commented upon the probable condition, at those periods, of the British Channel, the formation of which, while a late geological event, he was not prepared to admit to be one of the last. Even in the Pleistocene period the British Channel existed, although much narrower, and there was a line of cliffs running parallel with the present coasts. The sea being narrower, was frozen over every winter, permitting the passage of men and animals. Some of the great effects of such a cold period might already be conceived, although it might not be in our power as yet to accurately define them. In looking at a distant mountain-chain we could judge of its great magnitude without waiting for a trigonometrical survey to be assured of its exact dimensions. The author then suggested as a possible measure of time the perturbations in the increasement of heat at various depths in the earth's crust, arising from disturbances originating with the glacial period; and he concluded by giving his impression that in the existence of this remarkable cold period preceding our own, we might possibly trace evidence of great and allwise design by the circumstance that, in this long glacial era, the earth's crust would tend to acquire an earlier adjustment in its equilibrium, and obtain a rigidity and stability which should make it more fitting for the habitation and pursuits of civilized man.

FOREIGN INTELLIGENCE.

M. G. de Mortillet has published* a map of the ancient glaciers of the Italian flanks of the Alps, in which the former greater extension of the glaciers in the quaternary period and their present retracted limits are marked out. The space occupied by these glaciers extended to the valley of the Stura, near to the Col de Tende, as far as the environs of Udine. The author believes that the lakes on the southern flank of the Alps have been scooped out of the soft rocks by the grinding action of the glaciers. The *résumé* of his theories is, that after the last upheaval of the Alps there were formed enormous deposits of horizontally stratified alluvium, which attained great thickness. These alluvial beds exist above and below the large Italian lakes; over them repose the glacial beds, with striated pebbles and unrolled erratic blocks. This deposit has been left by the glaciers, which then advanced more or less over the plain. These glaciers, in clearing out the great basins filled with the ancient alluvium, have scooped the site of the present valley. They drove before them the materials which they brought down, and these were heaped up in their terminal moraines. The alluvial beds deposited during the great extension of the glaciers, have formed a continuation of the ancient alluvium, and during the period of retreat the streams of water have deeply excavated the anterior or older deposits. They have scooped longitudinal terraces, which border their present courses, and have not been able to fill up the great depressions which now are the lakes.

An "Essai sur les Conditions générales des Couches à *Avicula contorta*, sur la constitution géologique et paléontologique spéciale de ces mêmes couches en Lombardie, et sur la constitution définitive de l'Etage Infra-Liasien," by the Abbé Stoppani, has been published in Milan (4to, 1861). It is divided into three parts—the first containing bibliographical notices, or rather an historical *résumé* of the study of the beds forming the horizon of the *Avicula contorta*, followed by a description of the characters of these beds, and an indication of their thickness. In England they appear to be very thin; on the northern flanks of the Alps they are some twelve mètres thick; while in Lombardy they attain to eight hundred or a thousand feet. Their geographical area is of considerable extent; they are met with in England, Ireland, Wurtemberg, Bavaria, Westphalia, Luxemburg, in the departments of the Moselle and the Meurthe, Côte d'Or, Yonne, Rhone, Cévennes, Savoy, Switzerland, in the Vorarlberg, and at other points in the chain of the Alps as far as Hungary—everywhere forming a convenient and decided band. The second part of the Essay gives a more special description of these *Avicula contorta* beds in Lombardy, where they have previously been studied by Collegno, Escher, and Omboni. In the third part the author shows that, on palæontological grounds, these beds must be placed in the Jurassic series, and that they are sufficiently important and sufficiently clearly separated from the beds above and below them to form a separate division, which he terms the *Etage Infraliasien*. He indicates exactly the synonyms of other countries, the principal of which are the beds of Kœssen in Austria; the "Bone-bed" and White Lias in England; the "Cloac" of Wurtemberg; the sandstone of Helmsingen and of Lævelange, in Luxemburg; the sandstone of Hettange; the zone of *Ammonites planorbis* and *A. angulatus* of M. Oppel; the limestone of Halberstadt;

* Atti della Soc. Italiana de Sc. Nat. in Milano, 1861, t. iii.

the limestone of Valognes; the "chôin bâtard" of Lyon; the "foie de veau" of Bourgogne; the Sinemurien in part of D'Orbigny; the "quatrième étage" of the Lias of D'Archiac; the upper dolomite of Lombardy, etc. In the tabular view which the author gives, the *Etage Infraliasien* is placed below the zone of *Ammonites Bucklandi*, and is formed in the following manner:—

1. Zone of *Ammonites angulatus*.
2. Zone of *Ammonites planorbis*.
3. Zone of *Terebratula gregaria*.
4. Zone of *Bactryllium*, reposing on

THE KEUPER.

Henceforth, if the author's views are correct, these *Avicula contorta* beds would serve as the lower limit of the Jurassic formation, and will form a datum line of great importance in studying the geology of the Alps. The Essay appears to be an extract from the excellent memoir by the Abbé, "The Palæontology of Lombardy."

M. Morlot has given an account, in the 'Indicateur de Suisse,' of the finding of a part of a nodule of pyrites amongst the remains of the lake-dwellings of the Stone-age at Robenhausen by M. Messikommer, which was furrowed by striking it against some hard substance, probably for the purpose of obtaining fire. Many fragments of pyrites have previously been found at the same place and at Wangen. Another specimen, as large as the first, and evidently used for the same purpose, has recently also been found by M. Engelhardt, amongst a great number of different antiquities, dating from the earliest ages to our own era, in a peat-bed at Sönder Brarup, in Denmark.

NOTES AND QUERIES.

Cutting Diamonds.—There still seem to be, in the minds of most persons, some wrong notions relative to the manner of cutting diamonds, and especially this is the case in London. Although several notices and descriptions of diamonds have appeared in various serials and magazines of late, none of them describe the process of cutting, except in such a vague and unintelligible manner as to impress upon the minds of readers a similarity of the method of cutting, to that of other stones. The principle, it is true, is somewhat the same, but the operation is distinctly different. It is also generally stated, that the workmen have such a very perfect knowledge of the crystallography of the diamond as to enable them to cleave it very readily. The fact is they know nothing whatever of crystallography,—at least as a rule,—and only cleave the crystals by experience. As to why a diamond should cleave in a certain direction, they cannot tell, nor could they explain why they strike it on one particular spot in order to do so. It is also generally stated that diamonds are cut on the principle of "diamond cut diamond," two crystals being rubbed together till a facet is produced. They are certainly rubbed together to get them a little into shape; but how? If the reader rub two crystals of diamond together, he will find that he hardly makes an impression on either; but if the stones are inserted in metal and attached to a holder, and these held in the hands, which are rested on a bench, the thumbs towards each other, then it will be found that the mechanical power or leverage obtained is very great, even sufficient to crumble and break such hard material as diamond; but this process must be seen to be perfectly understood. The fragments and dust crushed off fall into a metal sieve, which separates the smaller from the larger particles; both are used for cutting and polishing purposes,—the larger, under the name of *splint*, for engraving stone seals, drilling, and slitting; the finer particles, after being beaten in a steel mortar of the required fineness, for the cutting of diamonds. Diamond *boart*, which is the massive opaque variety, is also used for the same purposes as splint. The impure crystals having sharp cutting angles are used by glaziers: these are of no value as gems.

With regard to cutting, it is generally stated that the diamond is first imbedded in fusible metal, the reason why is not given; but it is as follows:—In cutting diamonds the soft iron wheel, which is charged with diamond powder and oil, revolves with such amazing rapidity, either by steam or some other power, that if the diamond were merely attached to cement, as rubies, sapphires, and all other stones are, to be cut, the heat caused by the friction would melt or soften the cement so that it would be impossible to cut it; but the heat generated by the wheel revolving is not sufficient to melt the metal. The smallest rose diamonds, even of 800 to the carat, or 200th of a grain weight each, have thus to be placed in fusible metal. Of these, as also small brilliants, three or more are cut at one time. The wheels for cutting other stones than diamonds revolve at the rate of from 100 to 300 times in a minute.

Another peculiarity in the process of cutting diamonds is the polishing. This is effected on the same wheel and almost at the same time as the cutting, and with the same material—crushed diamond. No other stone is so cut and polished at the same time. Some have two or three polishing materials, which are always much softer than the stone to be cut.

These few remarks on cutting diamonds will be, I think, understood, although it is a process that ought to be seen to enable any one completely to appreciate the difference in the respective physical characters and mineralogical peculiarities of the diamond in respect to other stones.—
JAMES R. GREGORY, 25, *Golden Square, London.*

SEPARATION OF THE ISLE OF WIGHT.—Sir,—You are of course well aware of the famous passage in Diodorus Siculus (lib. v. cap. 22), which is now interpreted by Sir G. C. Lewis and the latest German philologists as referring, not to St. Michael's Mount, but the Isle of Wight. There the writer expressly says that in his time the passage at low water was dry.

Now we have in this neighbourhood, of which you may not be aware, various traditions to the same effect, such as that the Cistercian monastery of Beaulieu was built of Binstead stone, brought across from the Isle of Wight in carts at low tides.

I. I should be glad to know if these assertions have any truth in them, and to what period you date the separation of the Isle of Wight, between Calshot Point and Hurst Castle, from the mainland?

II. Can you refer me to any good book or article on the subject?

Your constant reader,

Lymington, Hants. W. B. H.

GEOLOGICAL TABLES.—The Synoptical Tables of British Geology in use by Professor King, of Galway, having been highly thought of by teachers of our science, we are happy to be able, through the Professor's kindness, to present our readers with a new edition, which he has revised and corrected up to the present time, expressly for this magazine.—ED. GEOL.

SYNOPTICAL TABLE OF BRITISH AQUEOUS ROCK-GROUPS, ARRANGED IN THEIR ORDER

⁎ Each Group represents a Geological Perioc

Taking the smallness of its area into consideration, no country equals England in the extent of illustrating the geologica on the Continent. In North America the Secondar

CLASSES.	SYSTEMS.*	FORMATIONS.—MARINE TYPES.
TERTIARY. —Cainozoic of *Phillips*.	POST-PLEISTOCENE (Or Post-Pliocene)—*Lyell*.	Deposits now forming around the shores of the British Islands. . . . . Blackpool (Lancashire) Shell-sands. Belfast low-level (British) Shell-clays. . . . . Devonshire Raised Beaches. ? Portrush Shell-gravel.
	PLEISTOCENE—*Lyell* (Glacial—*Forbes*).	Kelsey (near Hull) Marine Shell-sands, with *Corbicula fluminalis*. Howth (near Dublin) *Cytherea Chione*, Gravel. . . . . English Midland sub-Arctic Shell-gravels. Wicklow and Antrim Shell-clays. ? Selsea (Sussex Levels) "Yellow Drift-clay" (Godwin-Austen). . . . . Lanarkshire (Arctic) Shell-clays.
	PLIOCENE—*Lyell*. Contains *more* (a large number) existing sp. of shells than occur in the two next antecedent Systems.	Norwich Crag. Bridlington and Chillesford Shell-clay. . . . . Walton Naze (Essex) Red Crag. Wexford Shell-gravel. . . . . Suffolk Crag.
	MIOCENE—*Lyell*. Contains a *less* number of existing sp. than the Pliocene.	(Not known in British Isles: possibly swept off by denudation. Occurs in France, Germany, Belgium, etc.)
	EOCENE—*Lyell*. The earliest System containing living (few) species of shells,—the *dawn* of existing testaceous life.	Barton Clay. . . . . Bracklesham Clay. . . . . London Clay and Thanet Sands.
SECONDARY. —Mesozoic of *Phillips*.	CRETACEOUS. Characterized by Chalk (*creta*) rocks.	(Not known in British Isles.) Maestricht and Belgium. Tuff-chalk, et . . . . South of England Chalk. Antrim "White Limestone. . . . . Gault, and Wiltshire ("Upper") Greensand. Antrim "Mulatto Stone.
	NEOCOMIAN. Type deposits occur at Neufchatel (*Neocomum*) in Switzerland.	Atherfield (Isle of Wight) clay. (The lowest marine portion of this System appears not to be developed in British Isles.)

* The student is strongly recommended to commit the column of "Systems" to memory.

F SUPERPOSITION AND IN CHRONOLOGICAL SEQUENCE. By Professor William King.

Time, the Laurentian being the Oldest.

cords of our Earth: with a few exceptions (Miocene) it contains all the Rock-systems occurring, often widely separated, stems appear to be incompletely developed.

Freshwater Types.	Life-Characteristics of the different Systems or Periods.†
Peat, Marl, and other deposits now forming in Lakes, Rivers, etc. Cornish Submarine Forests with Human Remains. ? Irish *Megaceros* Marls and Peat.	Of Pleistocene Ruminants, the Scotch gigantic Fossil Ox (*Bos primigenius*), and small Fossil Ox (*Bos longifrons*—probably original of our domestic breeds), lived on to latest (Historic) division of this Period. ? Same may be said of the Irish *Megaceros*. The great Aurochs (*Bison priscus*) is still living in Lithuanian Russia, but preserved by strict protective laws. ? Special Organisms:—Shells—*Lima excavota*, *Haliotis tuberculata*, *Natica Kingii*, *Litorina litoralis*, *Fusus Berniciensis*, and *F. Norvegicus*.
River Air (Yorkshire) *Hippopotamus*, Alluvium. Thames Valley, *Elephas primigenius*, and Hoxne Flint-implements Gravels. ? Maidenhead (Berkshire) "High-level Gravel" (Prestwich). West of Ireland Escar Drift, and (? iceberg-transported) granite erratics. North of England Boulder-drift. West of Ireland (? field and mountain glacier) Limestone-drift.	British Spec. Org.!—Shells—*Mya Uddevallensis*, *Rhynchonella psitiacca*, *Natica clausa*, *Pecten Islandicus*, etc.; Mammals—Reindeer, Musk-buffalo (all the foregoing are now only living in Arctic regions!),—*Elephas primigenius* (Mammoth), *E. antiquus*, *Rhinoceros tichorhinus*, *Hippopotamus major*, gigantic Irish Deer (*Megaceros Hibernicus*), Cave Bear, Cave Lion (these have all died out!), and certain bovine Ruminants. The genus *Homo* characterizes this and the following (Post-Pleistocene) Period; manufactured flint implements having been found at Hoxne (Suffolk) and other places (also in France), under circumstances proving that a low (? extinct species) tribe lived coevally with the extinct Mammals last-named.
Happisburgh (Norfolk) *Elephas meridionalis* bed. Felixstow (*Mastodon*) detrital bed.	Monkeys (*Macacus pliocenus*) still existing. A large increase of recent shells; Suffolk Crag containing 50, Walton Crag 57, and Norwich 85 per cent.! Spec. Org.:—Mammals—*Elephas meridionalis* (? one of the earliest British species of true Elephants), *Mastodon Arvernensis* (? existing not later than Red Crag), *Rhinoceros Etruscus*; Shells—*Astarte Omalii*, *Nucula Cobboldiæ*, *Cassidaria bicatenata*, *Natica catenoides*, *Nassa reticosa*, *Voluta Lamberti*. Earliest (Suffolk) Crag species, Southern forms; latest (Norwich), northern!
Bovey Tracey (Devonshire) Lignite. Lough Neagh Lignite. ? Isle of Mull Lignite. ? Hempstead (Isle of Wight) beds.	Elephantine (*Mastodon angustidens*) and other Pachyderms, as *Acerotherium* (Rhinoceros-like), *Dinotherium* (allied to Dugong), exist; also a large Ape (*Dryopithecus*), exceeding in size the Gorilla! Recent shells mostly of sub-tropical forms, increase to 25 per cent.:—Special species—*Leda Deshayesiana*, *Pectunculus crassus*, *Oliva Dufresnii*, *Proto cathedralis*, *Cerithium plicatum*. None of these occur in British Islands; only in France, Belgium, and Germany.
Bembridge Marls. Hordwell Marls and Sands. Sheppey Clay (Estuarine).	Mammals of high types now abound (*Palæotherium*, *Coryphodon*, *Dichobune*), all belonging to extinct genera. East Indian-like Monkeys (*Macacus eocenus*); also reptiles severally resembling the Gavial of India, the Crocodile of Borneo, and the Alligator of America, living in England! Vegetation that of the Indian Islands. Shells mostly of tropical types—under 5 per cent. identical with recent species: special—*Cerithium giganteum*, *Volutilithes spinosus*, *Venericardia planicosta*, *Axinus angulatus*, *Nautilus imperialis*, *Aturia ziczac*. Nummulites (Protozoons) characterize this period.

In the British Isles there is a great Life-break between the Eocene and the Cretaceous System; the former rarely contains any species of plants and animals characterizing the Secondary periods: probably, in other regions there may be a closer fossil agreement between the two Systems, caused by their containing other coterminous Formations; or there may exist an intermediate System.

Freshwater Types.	Life-Characteristics of the different Systems or Periods.†
	True dicotyledonous Plants (*Credneria*) appear. Horn-scaled Fishes (*Beryx*, *Osmeroides*) replace early enamel-scaled kinds. Ammonites much reduced in numbers, giving way to singular forms allied to them, as *Turrilites*, *Scaphites*, *Baculites*, etc. Spec. Org.:—Shells—*Hippurites*, *Magas*, *Kingena*, *Ostrea vesicularis*, *Inoceramus*, *Spondylus spinosus*, *Ammonites Sussexiensis*, *Belemnitella*; Echinoderms—*Galerites*, *Micraster*, *Ananchytes*, *Marsupites*. Many shells *approach* to recent forms. Marine Lizards, few—*Mosasaurus*, etc.; Flying Lizards, still living, and of large size.
Weald Clay and Hastings Sand. ? Portland Dirt-bed and Purbeck Marlstone.	Enormous Land Lizards (*Iguanodon*, *Hylæosaurus*) inhabiting the Palm (*Clathraria*), Cycas (*Mantellia*), and Pine (*Abietites*) forests of the region of Kent. Several small Insectivorous Mammals and Marsupials exist (Purbeck Marl)—*Spalacotherium*, *Triconodon*, etc. Spec. Org.:—Shells—*Corbis corrugata*, *Perna Mulleti*, *Exogyra*, *Pterocera Beckleseii*, *Ammonites Deshayesii*, *Ancyloceras*, *Crioceras*; Fishes—*Lepidotus Fittoni*, *Macropoma Egertoni*.

† In reading this column, the student should begin with the bottom System, the Laurentian.

CLASSES.	SYSTEMS.	FORMATIONS.—Marine Types.
SECONDARY. —Mesozoic of *Phillips* (continued).	JURASSIC. Well developed in the *Jura* Mountains.	Portland (Dorsetshire) Oolite. Somerset *Teleosaurus* Upper Lias. Oxford Clay. Bath Oolite. ? Larne (Antrim) mixed Fossil Bed.
	LIASSIC. From Lias, the name of certain rocks, usually in *layers*, the latter word being sounded by the quarrymen like lias.	Yorkshire Alum-Shales. Gloucestershire Marl-Stone. Lincolnshire and Somersetshire Lias. { Liassic Rocks occur in Londonderry (Magillican, Portrush) and Antrim (Cave Hill, Collin's Glen, Ballintoy).
	TRIASSIC. From apparently consisting of *three* members (Keuper, Muschelkalk, and Bunter) in Germany.	Cheshire Marls, with Salt. Carrickfergus ditto. Gloucestershire and Londonderry (Lisnagrib) *Avicula contorta* beds. (Not known in Britain.) German Muschelkalk. Lancashire Red and Mottled Sandstone. (Probably much of it freshwater.) ? St. Cassian (Tyrol) and Hallstatt (S.E. Salsburg) Limestones.
PRIMARY. —Palæozoic of *Sedgwick*.	PERMIAN—*Murchison*. From *Perm*, a country in Russia, where a well-developed series of the System occurs.	Sunderland and Hartlepool (Durham) Crystalline and Oolitic Limestones. Brotherton (Yorkshire) beds. Andtrea (Tyrone) and Cultra (Down) Magnesian Limestone. German "oberer Zechstein." Manchester Marls. Humbleton and Tunstall (Durham) "fossiliferous Limestone." Doncaster and Pontefract (Yorkshire) Limestone. German "mittler Zechstein." Midderidge (Durham) Marl-slate and compact Limestone. German Kupferschiefer and "unterer Zechstein." Gera (Thuringia) *Rhyncopora Geinitziana* Weissliegende. ? Ferry Hill (Durham) *Lingula* Sandstone.
	CARBONIFEROUS. Characterized by deposits of Coal or *Carbon*.	(Not known in British Isles.) ? Artinsk (Russia) Grits. Redesdale (Northumberland) and Yoredale (Yorkshire) Limestone. Lisdoonvarna (Clare) Shales. Galway ("Upper") Limestone. Bristol Limestone. Cork ("Lower") Limestone. Tweedian beds (*Tate*). Bantry Bay (Cork) Calcareous Schists.
	DEVONIAN —*Sedgwick and Murchison*. Individuality of the System first made out in *Devonshire*.	Petherwin Slates. South of Ireland Old Red Conglomerate. Fifeshire Sandstones. Marwood Sandstones. Coomhola (Cork) Grits. Plymouth Limestone. Dingle (Kerry) beds. Caithness Schists. Linton Sandstones. Glengariff Grits. Herefordshire Cornstones.
	SILURIAN—*Murchison*. Type rocks occur in a portion of Wales, anciently inhabited by a tribe called *Silures*.	Ludlow Shales, etc. Doonquin (Kerry) beds. Wenlock Limestones. Ferriter's Cove (Kerry) Shales. Llandovery Grits (May Hill Group). ? Kilbride (Connemara) beds. Caradoc Sandstone. Portrane (Dublin), ? Pomeroy (Tyrone), Chair of Kildare. Llandeilo Flags. Newtown Head, near Waterford.
	CAMBRIAN—*Sedgwick*. Type rocks occur in *Cambria* (Wales). (Huronian, *Logan*; Primordial zone, *Barrande*; Taconic, *Emmons*.)	Tremadoc (Caernarvonshire) Lingula Flags. Shropshire "Stiperstones." Longmynd (Shropshire) Rocks. Bray Head (Wicklow) Flags. Ross-shire Conglomerate and Sandstone. (This System probably contains more Formations. The Longmynd Rocks are estimated at 26,000 feet in thickness!)
	LAURENTIAN—*Logan*. Forming the *Laurentide* mountains of Canada. (Lewisian, *Murchison*.)	"Fundamental Gneiss" of the Island of Lewis and north-western Highlands of Scotland. Estimated at 40,000 feet in thickness in Canada!

Freshwater Types.	Life-Characteristics of the different Systems or Periods.
G thorp (Yorkshire) Plant-beds.	Mammals still low (Marsupials—*Phascolotherium*), but increasing; *Stereognathus* appears to be higher. Elephant-sized Reptiles (*Megalosaurus*), Flying Lizards, some with *membranous* wings (*Pterodactylus*), others with fan-shaped *feathered* wings (*Griphosaurus*), and new paddled Saurians (*Pliosaurus*), tenanting the land, air, and water respectively. Spec. Org.:—Plants—*Otopteris, Palæozamia*, and others allied to Cycases; Shells—*Opis, Trigonia clavellata, Myoconcha, Pholadomya fidicula, Nerinæa, Purpurina, Ammonites Humphresianus*; Echinoderms—*Apiocrinus, Nucleolites, Acrosalenia*; Fishes—*Pycnodus, Strophodus*.
	Period of marine paddled Reptiles (*Ichthyosaurus, Plesiosaurus*, Cuttle-fish-snake-shells (*Ammonites*—species in vast numbers) and plumose peduncled Star-fishes (*Extracrinus*). Spec. Org.:—Shells—*Hippopodium, Cardinia Listeri, Gryphæa incurva, Leda ovum, Spiriferina, Belemnites acutus* (Cuttle-fish bones), *Ammonites bifrons, A. heterophyllus*; Fishes—(enamelled) *Eugnathus, Dapedius*, (Shark) *Hybodus reticulatus*. Peculiar Crocodiles (*Teleosaurus*).
(I ce of the German Keuper.) (I ce of the German (Upper) Bunter.)	The earliest period known for Mammals (*Microlestes*), which are low! Totally new Reptiles—*Mastodonsaurus* (large and toad-like), *Placodus*, etc., replace earlier kinds. New Fishes *Saurichthys, Ceratodos, Ischypterus*) appear, most primary kinds having died out! Spec. Org.:—Shells—*Myophoria, Bakevellia socialis, Allorisma musculoides, Ceratites* (link between Carboniferous *Goniatites* and Jurassic *Ammonites*); Crinoids—Lily-encrinite.
	In the British Isles there is a great Life-break between the Triassic and the Permian System; the former rarely contains any species of plants and animals characterizing the Primary periods: probably, in other regions there may be a closer fossil agreement between the two Systems, caused by their containing other coterminous Formations; or there may exist an intermediate System.
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L ashire and Durham Coal-measures. ? I sh Coal-measures. ? Inferior portion of South Welsh al-measures. ? I vonshire Culm. E burgh "Calciferous Sandstone."	Singular Plants (*Calamites, Lepidodendron, Sigillaria, Sphenopteris*, etc.) abound, their debris forming Coal beds! Reptiles (*Parabatrachus, Apateon*) of lowest (fish-like) kinds appear! Spec. Org.:—Corals—*Michelinia, Lithostrotion*; Shells—*Productus, Spirifer, Edmondia, Anthracosia, Goniatites*; Crinoids—*Platycrinus, Woodocrinus, Pentremites*; Crabs—*Griffithides* (Trilobites becoming rare), *Bellinurus*; Fishes—*Megalichthys, Dendrodus* (rivalling Crocodiles in size), *Psammodus, Palæoniscus*.
K ktopher (Kilkenny Plant-beds).	Period of cuirassed (Placoganoid) Fishes (*Pterichthys, Coccosteus*)! Spec. Org.:—Corals—*Cyathophyllum cæspitosum, Favosites Goldfussi, Pleurodictyum*; Shells—*Davidsonia, Calceola, Stringocephalus, Megalodon, Clymenia*; Crinoidal Echinoderms—*Hexacrinus*; Trilobites—*Bronteus flabellifer, Phacops latifrons*; Fishes—(enamel-scaled or Lepidoganoid) *Osteolepis, Glyptolepis, Diplacanthus*. Terrestrial Plants exist—*Cyclostigma, Aparoxylon*, etc.
	Period of *Graptolites* (Zoophytes), straight-chambered Shells (*Orthoceros*), and Trilobites (*Asaphus, Acidaspis, Phacops*). Singular helmeted (Placoganoid) Fishes (*Pteraspis, Cephalaspis*, etc.), first found in latest (Ludlow) Formation! Spec. Org.:—Corals—*Heliolites, Halysites*; Shells—*Pentamerus, Murchisonia, Maclurea, Lituites*; Peculiar Echinoderms (Sea-urchin Group)—*Sphæronites, Eucalyptocrinus, Palæaster* (ancient Star-fish).
	Plants (apparently Sea-weeds) and Animals rare; latter more abundant in America and Bohemia. Certain low forms, viz.: (Zoophytes) *Oldhamia* (in Bray rocks), *Dictyonema*, (Shell) *Lingula Davisii*, (Crabs of the Trilobite group) *Palæopyge, Conocephalus, Paradoxides, Olenus*, etc., (? a Phyllopod Crab) *Hymenocaris*, (Annelids) *Scolithus* and *Histioderma* are *Special Organisms* of this Period.
	No traces of Life yet discovered in British rocks of this Period, though strong indications occur in America (Sterry Hunt).

C ected for the 'Geologist.'

CLASSES.	SYSTEMS.	FORMATIONS.—MARINE TYPES.
SECONDARY.—Mesozoic of *Phillips* (continued).	JURASSIC. Well developed in the *Jura* Mountains.	Portland (Dorsetshire) Oolite. Somerset *Teleosaurus* Upper Lias.
		Oxford Clay.
		Bath Oolite. ? Larne (Antrim) mixed Fossil Bed.
	LIASSIC. From Lias, the name of certain rocks, usually in *layers*, the latter word being sounded by the quarrymen like lias.	Yorkshire Alum-Shales.
		Gloucestershire Marl-Stone. Liassic Rocks occur in Londonderry (Magillican, Portrush) and Antrim (Cave Hill, Collin's Glen, Ballintoy).
		Lincolnshire and Somersetshire Lias.
	TRIASSIC. From apparently consisting of *three* members (Keuper, Muschelkalk, and Bunter) in Germany.	Cheshire Marls, with Salt. Carrickfergus ditto. Gloucestershire and Londonderry (Lisnagrib) *Avicula contorta* beds.
		(Not known in Britain.) German Muschelkalk.
		Lancashire Red and Mottled Sandstone. (Probably much of it freshwater.)
		? St. Cassian (Tyrol) and Hallstatt (S.E. Salsburg) Limestones.
PRIMARY.—Palæozoic of *Sedgwick*.	PERMIAN—*Murchison*. From *Perm*, a country in Russia, where a well-developed series of the System occurs.	Sunderland and Hartlepool (Durham) Crystalline and Oolitic Limestones. Brotherton (Yorkshire) beds. Andtrea (Tyrone) and Cultra (Down) Magnesian Limestone. German "oberer Zechstein." Manchester Marls.
		Humbleton and Tunstall (Durham) "fossiliferous Limestone." Doncaster and Pontefract (Yorkshire) Limestone. German "mittler Zechstein."
		Midderidge (Durham) Marl-slate and compact Limestone. German Kupferschiefer and "unterer Zechstein."
		Gera (Thuringia) *Rhyncopora Geinitziana* Weissliegende. ? Ferry Hill (Durham) *Lingula* Sandstone.
	CARBONIFEROUS. Characterized by deposits of Coal or *Carbon*.	(Not known in British Isles.) ? Artinsk (Russia) Grits.
		Redesdale (Northumberland) and Yoredale (Yorkshire) Limestone. Lisdoonvarna (Clare) Shales. Galway ("Upper") Limestone.
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(Place of the German Keuper.) . . . . (Place of the German (Upper) Bunter.)	The earliest period known for Mammals (*Microlestes*), which are low! Totally new Reptiles—*Mastodonsaurus* (large and toad-like), *Placodus*, etc., replace earlier kinds. New Fishes *Saurichthys, Ceratodus, Ischypterus*) appear, most primary kinds having died out! Spec. Org.:—Shells—*Myophoria, Bakevellia socialis, Allorisma musculoides, Ceratites* (link between Carboniferous *Goniatites* and Jurassic *Ammonites*); Crinoids—Lily-encrinite.
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Corrected for the 'Geologist.'

The Griphosaurus.—"On a New Fossil Reptile, supposed to be furnished with Feathers," by A. Wagner. The above is the title of an article which occupies the most prominent position in the pages of our contemporary the 'Annals and Magazine of Natural History' for April, and is translated by W. S. Dallas, F.L.S., from the 'Sitzungsberichte der Münchner Akad. der Wiss.,' 1861, p. 146.

In it is detailed the account of a conversation held between Prof. Wagner and M. Witte, of Hanover, in which the latter gentleman described that he had seen a skeleton in the possession of M. Häberlein, of Pappenheim, from the lithographic slate of Solenhofen, "with such a combination of characters that nothing more surprising and odd could be imagined. This specimen, indeed, wanted the skull and the two hands, but in other respects the most important parts of the skeleton were well preserved. The most remarkable thing about it was, that a well-marked coat of feathers was present, both on the anterior limbs and on the tail. These feathers agreed in their configuration so exactly with those of true birds, that their interpretation as such could hardly be doubted. The discovery of feathers in the lithographic slate was of itself something unprecedented, but the mode of their union with the skeleton bordered on the incredible. Thus, the tail-feathers were attached to a tail possessing not the least resemblance to that of a bird, but presenting a deceptive similarity to that of a *Ramphorynchus*. And the attachment of the wings was still more astonishing; for these, on both the anterior limbs, formed a fan, radiating from the extremity of the fore-arm."

This information, coming from a man whose judgment Prof. Wagner "could not but respect as that of one well acquainted with the subject," naturally caused doubt in the mind of the learned German Professor. The discovery by Herman v. Meyer, of authenticated evidence of feathers in the Solenhofen slate ('Geologist,' vol. v. p. 74) seemed to afford an additional corroboration of M. Witte's statement. A friend of Wagner, however, whose name has not transpired, sent to him a report upon the specimen, which we transcribe *verbatim*:—"Skull, neck, and both hands wanting. Of the vertebral column, the greater part of the vertebræ of the trunk, and the whole of those of the tail, are completely preserved. The former are of moderate length and uncovered; the tail, which measures upwards of six inches, consists of about twenty vertebræ of an elongate narrow form, the dimensions of which slowly but constantly diminish, so that the last of them is the smallest. Of the anterior limbs, the humerus and fore-arm are present on both sides; they are strong bones, pretty nearly of equal length, and the fore-arm consists of radius and ulna. At the anterior extremity of each fore-arm, there is a broad, short bone, but this is uninjured. Of the pelvis only the right half is preserved; it is but small, and is comparable, not with the pelvis of a bird, but rather with that of a Pterodactyle. On the left side, the whole hinder extremity is preserved; on the right, only the thigh and shank. The former is a powerful and not very long bone; the latter is somewhat longer and thinner, and is simple—at least, a separation into tibia and fibula is not perceptible. The tarsus consists only of a single powerful bone, which is shorter than the shank bone with which it is in contact; its lower extremity is considerably widened, and bears three articular processes, to which the three toes are attached. The latter are of moderate length, and armed with strong hooked claws. Feathers occur both on the anterior limbs and on the tail; they have, however, left only their impressions, but these show sharply-defined outlines, and upon a passing glance they present a deceptive resemblance to birds' feathers. From the above-mentioned short, broad bone, which lies close to the extremity of each fore-arm, there issues a radiate fan of feathers, by which, therefore, as a structure of this kind radiates from each fore-arm, two feather-wings are produced, having their external outline curved like a bow. The individual feathers are characterized by their fine shafts, on each side of which the delicate striation of the vanes is seen. The largest of these feathers considerably exceed in size that described by Von Meyer. Similar feathers are attached to the tail, but with this distinction, that they do not attain the length of the wing feathers, and, which is of more importance, they do not radiate like the latter from one central point, but spring from both sides of the tail throughout its whole length, and start from it at a small angle. The tail-feathers form a group of an elongated leaf-like or oval shape, of which the narrow end issues from the beginning of the tail, whilst the posterior end is broadly rounded, and extends considerably beyond the last caudal vertebra."

On this report Professor Wagner, who had not seen the specimen himself, commented at great length. The characters which, according to him, indicate the ornithic affinity of this animal are—the clothing of the anterior limbs, and the tail with feathers, and the structure of the tarsus which forms a single bone, which has at its lower extremity three processes for the articulation of the three toes. The characters incompatible with the type of birds are—the insertion of the wing quills, not as in birds, along the whole outside of the hand and fore-arm, but only to a small bone probably belonging to the wrist, from which it radiates like a fan. "Equally strange is the mode of attachment of the feathers on the tail, from which they issue on both sides throughout its whole length uniformly amongst themselves, whilst the rectrices on the short tail of birds are only attached to the last vertebra." The vertebral structure is different from the ornithic type, "but agrees most closely with that of the long-tailed Pterodactyles (Ramphorhynchus)." In birds, the sacro-lumbar column is firmly anchylosed. In the fossil, it is free and uncovered. In birds, the tail is short and powerful, composed of from five to eight, and rarely nine or ten vertebræ, each bearing processes, the last being usually the largest. "In the fossil, the tail is extraordinarily long, and consists of about twenty vertebræ, which are all elongated, slender, and without processes, the last being the smallest." Such a structure accords with that of the long-tailed Pterodactyle.

In Professor Wagner's concluding remarks, he says, "A reptile with the simple tarsal bone of a bird, and with epidermic structures presenting a deceptive resemblance to bird's feathers, is far more comprehensible to me than a bird with the pelvis and vertebral column (especially the long slender series of caudal vertebræ) of a long-tailed Pterodactyle, and with a perfectly different mode of attachment of the feathers. To this we may add, that the identity of these epidermic structures with true birds' feathers is by no means proved; they might still only be peculiar adornments. Even amongst insects, we find peculiar structures to a certain extent reminding us of feathers; why therefore not also, and in a higher stage of development, among reptiles? If nothing of the kind has yet been found in the latter class, we have already been accustomed in palæontology to meet, in recent discoveries, with previously unknown peculiarities in the structure of different organs. Consequently, until I shall be convinced by the discovery, in another specimen, of the parts wanting in the one now under consideration, I do not hesitate to regard this as a reptile of the order *Sauria;* and I give it the name of *Griphosaurus,* derived from γρῖφος, an enigma."

He further hints that animals analogous to the *Griphosaurus* may possibly have produced the footprints of the Triassic sandstones, and concludes by suggesting that "Darwin and his adherents will probably employ the new discovery as an exceedingly welcome occurrence for the justification of their strange views upon the transformations of animals. But in this they will be wrong," as, according to Professor Wagner, "the intermediate steps by which the transition of some one living or extinct animal from one class into another was effected" cannot be shown. The failure of such proof, he says, induces us to reject their views "as fantastic dreams, with which the exact investigation of nature has nothing to do."

We have laid the above brief summary before our readers, and hope that some expression of opinion from our numerous contributors may be at once evoked. The problem is one which demands the highest efforts both of anatomists and geologists.

Glauconite in the Lower Silurian Rocks.—Mr. Sterry Hunt, in 1858, noticed, in 'Silliman's Journal,' that glauconite was probably the colouring matter of some Silurian sandstones; and in the Canadian Survey Report for 1859 he gave the analyses of this material from rocks of the Quebec group at Point Levis and in the Island of Orleans. In the latter rock there are layers which contain more than half their weight of soft, rounded, bright green grains, closely resembling the green sand of the Cretaceous period. These are a hydrous silicate of alumina and protoxide of iron, with about 8 per cent. of potash, and differ from glauconite of the secondary rocks in their larger proportion of alumina. A similar mineral is found in limestones of the Quebec group in Texas, and in the Potsdam sandstone of the Upper Mississippi. Sir Roderick Murchison has also recorded layers of green sand at the base of the Pleta limestone in Russia, and Schmidt in Esthonia and Livonia, in strata overlying the alum slates.

Canadian Pleistocene Fossils and Climate.—Professor Dawson has given, in the 'Canadian Naturalist,' a complete list of the fossils of the drift in Maine, Canada, Labrador, etc. His conclusions are, that a far greater degree of cold prevailed during the Pleistocene epoch than at present. The causes of this difference he attributes to great changes of level, and in the different distribution of land and water; during the cold period the relative proportion of land in the Arctic regions being greater than at present.

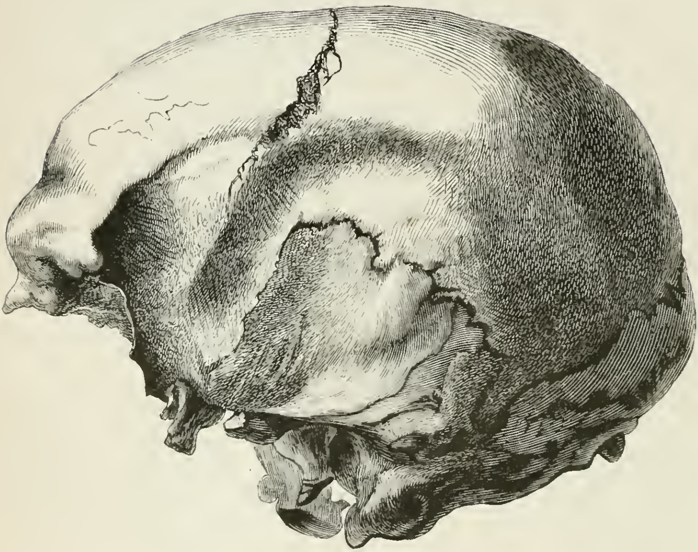
REVIEW.

Physico-Prophetical Essays, *on the Locality of the Eternal Inheritance, its Nature and Character, the Resurrection Body, and the Mutual Recognition of Glorified Saints.* By Rev. W. Lister, F.G.S., Vicar of Bushbury, and Rural Dean. London: Longmans.

This work deserves a notice in our pages, from the large amount of geology in it, the discoveries of which have been carefully employed in determining the meaning of some of the prophecies. We believe that many of our readers will be much interested with these portions of the work.

One great feature in Mr. Lister's volume is that it strives to fairly and fully prove that the Scriptures uniformly set before us a physical future, and that, in this respect, their authoritative declarations are in exact harmony with the logical deductions and suggestions of science.

We wish Mr. Lister's volume success, for the work, taken as a whole, is an *original* one.



HUMAN SKULL FROM MUSKHAM, IN THE VALLEY OF THE TRENT.

(Scale ½ linear.)

[In the Collection of Dr. Bever, of Newark.]

S. J. Mackie, F.G.S., del.

THE GEOLOGIST.

JUNE 1862.

NOTES UPON HUMAN REMAINS FROM THE VALLEY OF THE TRENT, AND FROM THE HEATHERY BURN CAVE, DURHAM.

By Prof. Huxley, F.R.S.

The skull from Muskham, in the valley of the Trent, a side view of which is given in Plate XI., like the animal bones with which it was associated, is stained of a dark-brown colour. The whole of those parts of the cranial bones which bound the cranial cavity are

Fig. 1.—Portion of Skull from Heathery Burn Cave.

well preserved; but the facial bones, with the exception of a small portion of the nasals, are broken away, so as to expose the whole of the under-surface of the base of the skull.

The considerable development of the frontal sinuses and of the different ridges and processes of the skull, shows it to be that of an adult, and the same characters lead me to believe that it belonged to a male. Otherwise it is small enough for a female, as its extreme length does not exceed 7·2 in., its extreme breadth 5·4 in., and its horizontal circumference 20½ inches.

The skull has a very peculiar form. If a line drawn from the glabella to the superior curved line of the occiput be made horizontal, the highest point of the longitudinal median contour of the skull will be seen to be situated about the middle of the length of the sagittal suture, and from this point the contour shelves rapidly downwards, to the brow on the one hand, and to the centre of the space between the apex of the lambdoidal suture and the occipital protuberance on the other. This last is the most prominent portion of the back part of the skull, the median contour below it bending forwards to the occipital protuberance, which is a very strong, projecting, triangular process. It follows from this description that a line taken from the glabella to the occipital protuberance is shorter than one from the glabella to a point midway between this and the lambdoidal suture. The difference between the two is about 0·3 of an inch. I find that crania differ a good deal in this respect, the occipital protuberance being in many, especially the lower races of mankind, the most backwardly situated part of the skull, when the glabello-occipital line is made horizontal, while in others, as in the present instance, the most posterior part of the skull is situated much higher up.

The line of greatest breadth of the skull is situated nearly in the same plane as that of its greatest height, in the position indicated, and the auditory foramina may also be said, roughly, to be intersected by that plane. The forehead is low and narrow, but not retreating. The supraciliary prominences are very well developed and, by their form, indicate the existence of large frontal sinuses. The space between the glabella and the nasal suture is not really very depressed, though on the side view of the skull it appears to be so, by reason of the projection of the supraorbital prominences.

The vertical height of the skull from the centre of the auditory foramen to the vertex is 4·8 inches, and the centre of the auditory foramen lies about 0·8 of an inch below the level of the glabello-occipital line.

The mastoid and styloid processes are well developed.

The base of this skull is remarkable in several respects. The occipital foramen is placed far back, and its plane is directed more backwards than is usual in human skulls. When the base of the skull is turned upwards and the glabello-occipital line is horizontal (its length being 6·7 inches), the anterior edge of the occipital foramen lies 1·5 inch above the line, and a perpendicular let fall from it would cut the line 3·9 inches from its anterior end. A similar line let fall from the posterior edge would cut the glabello-occipital line at 5·3 inches from its anterior end, and that edge is only 0·9 of an inch above it. In a length of 1·4, the plane of the occipital foramen, therefore, has a fall of 0·6 towards the glabello-occipital line.

In a well-formed European skull, whose glabello-occipital line measures 7·0 inches, while its extreme length is 7·25, the distance of the anterior edge of the occipital foramen from the glabella, measured in the same way along the glabello-occipital line, is 3·8 ; of its posterior edge 5·3. The anterior edge is 1·1 vertically above the line, and the posterior edge 1·0 above it. Thus, in a length of 1·5, the occipital foramen has a slope of only 0·1 inch, so that, instead of being greatly inclined backwards, it is nearly horizontal.

The skull from the Valley of the Trent belongs to a cranial type which seems at one time to have been widely distributed over the British Islands. I have seen skulls from rude stone tombs in Scotland with similar characters, and others obtained from the Valley of the Thames. There are skulls in the Museum of the Royal College of Surgeons exhibiting like proportions, from the remarkable tumulus at Towyn-y-Capel, Anglesea, described by the Hon. W. O. Stanley, M.P., in the 'Archæological Journal' (Institute) for 1846; and my friend Mr. Busk has shown me others from Cornwall. But the skulls which most clearly resemble the Trent cranium are some, also from river-beds, which I saw in the Museum of the Royal Irish Academy and in the collection at Trinity College, Dublin, and of which my friend, Dr. E. P. Wright, the curator of that collection, has been good enough to supply me with excellent casts. Two of these skulls are from the bed of the Nore, in Queen's County, and two from that of the Blackwater river, in Armagh, and one of the latter has the most extraordinary resemblance to the Trent skull, as the following table of measurements will show :—

	Trent.	Blackwater.
Maximum length	7·0	7·2
Length of glabello-occipital line	6·7	7·0

	Trent.	Blackwater.
Greatest vertical height from centre of auditory foramen, the glabello-occipital line being horizontal	4·8	4·7
Distance of auditory foramen below glabello-occipital line	0·8	0·7
Greatest transverse diameter	5·4	5·65
Transverse diameter at the lower edge of the coronal suture	4·4	4·75
Horizontal circumference	20·5	20·75
Transverse arc from one auditory foramen to the other	13·25	13·0
Antero-posterior arc from glabella to occipital protuberance	12·5	12·5
Antero-posterior arc from glabella to posterior edge of the occipital foramen	14·25	14·4

The plane of the occipital foramen of the Blackwater skull however is less inclined, so that this feature may be accidental in the Trent skull. The frontal sinuses are also less developed in the Blackwater skull, but in all other respects the resemblance is very close. The other Blackwater skull and one of the Nore skulls are also very like the Trent skull, but the remaining Irish skull from the Nore is much larger (having a length of 7·8 inches) and more depressed. It exhibits in a very marked manner, however, the projection of the superior part of the occipital bone beyond the occipital protuberance which characterizes the other skulls, and it retains a strong resemblance to them in its other peculiarites.

The Trent skull was found associated with bones* of the *Bos longifrons*, Goat, Red-deer, Wolf, and Dog, so that neither on this ground nor on any other that I am acquainted with does there seem to be any good ground for assigning to it a date earlier than the historic or immediately prehistoric epoch.

I have dwelt thus long upon the Trent skull because of its comparatively perfect condition, and because, so far as the imperfect condition of the fragments (fig. 2) from Heathery Burn Cave allow me to judge, they appear to belong to the same race of rather small and lightly-made men, with prominent superciliary ridges and projecting nasal bones. The few animal remains associated with them are all of recent species, and I see no reason for believing them to be of older date than the river-bed skulls.

* See 'Geologist,' vol. iv., 1861, pp. 246, 349, 415, and 495.

ON THE CRANIA OF THE MOST ANCIENT RACES OF MEN.

By Charles Carter Blake, Esq.

The authenticated discovery of human remains in strata of high historical antiquity in the Heathery Burn Cave, near Stanhope, and at Muskham in the Valley of the Trent, and the approaching discussion which "looms in the distance" of Palæontology consequent upon the proximate publication of Sir Charles Lyell's 'Antiquity of Man,' induce me to offer a few observations on the osteological nature of the evidences at present afforded to us of man contemporary with the mammoths, with a view, if possible, to determine the grade of the individuals whose remains have been preserved in suprapliocene strata.

The deposits on the banks of the Somme (Abbeville, St. Acheul, St. Roch), at Grenelle near Paris, at Hoxne in Suffolk, at Brixham and Kent's Hole in the south-west of England, under Gray's-Inn-lane in Middlesex, at Maccagnone in Sicily, the Kjökkenmöddings in Denmark, and at Wookey Hole in the Mendips, indicate to us the existence of man in a low state of civilization, as proved by his weapons, but of whom the osteological evidences have not yet been discovered. In these deposits the bones of extinct mammalia are found, as well as a more or less percentage of animals of existing species.

At Engis in Belgium, Massat in France, Aurignac in Gascony, Muskham in the Valley of the Trent, the Lake habitations in Switzerland, proofs of man have been found in strata contemporaneous with the most recently extinct animals.

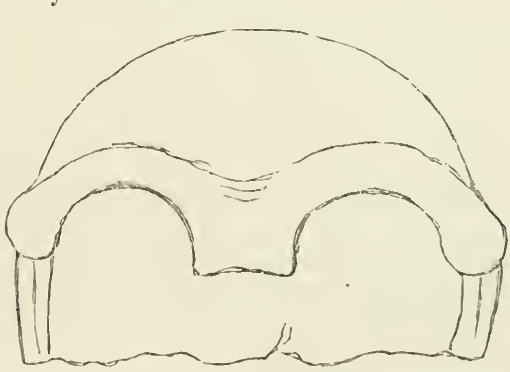


Fig. 1.—Front view of the Neanderthal skull (scale ½ linear).

Human remains have also been obtained from the Neanderthal, from Plau in Mecklenburg, Mewslade in Glamorganshire, Sennen in Cornwall, Montrose, Nether Urquhart in Fifeshire, Plymouth, East

Ham, and Heathery Burn Cave, Stanhope, of which the antiquity, however undemonstrated by the association of extinct animals, has been advocated upon more or less amount of geological evidence. Many other instances, but of less authentic value, might be added to the above.

I shall discuss *seriatim*, as briefly as possible, the recorded instances, before drawing those conclusions which seem to be capable of deduction from the facts before us.

With respect to the Neanderthal cranium,* unquestionably the most interesting of the evidences before us, I have briefly discussed in the 'Geologist,' vol. iv. p. 395, the question of its grade of organization. I hoped that English geologists would have thrown light upon the question of its age, and that a discussion might have arisen which would have established it either as a skull of comparatively modern antiquity, or as possibly coeval with the deposits of the Somme valley.† The apparent ape-like, but really maldeveloped idiotic character of its conformation is so hideous, and its alleged proximity to the anthropoid *Simiæ* of such importance, that every

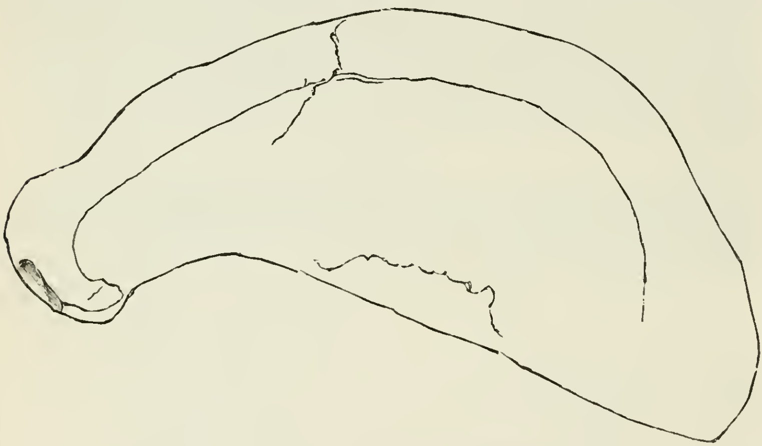


Fig. 2.—Side view of the Neanderthal skull (scale ½ linear).

effort should be made to determine its probable date in time. That such efforts have not been made, and that the evidence at present in possession of English palæontologists is wholly inadequate to enable us to draw any conclusion as to its being the representative of any given type of mankind, living or extinct, is the object of the following observations.

The fact has not yet been conclusively demonstrated to the satisfaction of English geologists that the Neanderthal skull is of high an-

* This skull is figured in the 'Geologist,' vol. iv. (1861) plate xi. p. 396.

† While this paper was going through the press, Professor Huxley, F.R.S., kindly permitted me to inspect the east of the Neanderthal skull in his possession. I see, however, as yet no sufficient grounds to infer its representing a distinct race of men.

tiquity. The time required for the deposition of the four or five feet of mud in the cave might have been accomplished in a comparatively short space of time. It is not stated at what height in the deposit the bones were found.

Dr. Schauffhausen's statement, "that the bones adhere strongly to the tongue, although, as proved by the use of hydrochloric acid, the greater part of the cartilage is still retained in them, which appears, however, to have undergone that transformation into gelatine which has been observed by Von Bibra in fossil bones," is hardly precise enough to convince practical geologists of the antiquity of the skull. But of the Engis cranium no such evidence is afforded us. It is hardly necessary to repeat the arguments made use of by Buckland against Schmerling at the meeting of German naturalists at Bonn, which proved the less degree of gelatine in the fossil hyæna bones than in the human remains from the Belgian cave deposits. The condition of the Vale of the Trent skull, which has been apparently immersed in glue or some analogous liquid since its disinterment, has deprived us of the only chemical evidence which could have decided the question of its antiquity. Professor Huxley admitted to his audience at the Royal Institution (Feb. 7, 1862) that, with respect to the Neanderthal cranium, "its great antiquity was not directly proved, although its date was undoubtedly very early."* Professor Huxley went on to say, that in the Museum of the College of Surgeons there are Australian skulls which closely correspond in configuration and development with those of the caverns of Engis and the Neanderthal, the differences between which latter were "hardly greater than occurred between individuals of that race, while in form the ancient and Australian skulls presented many analogies."

There are several suspicious circumstances connected with the Neanderthal cranium, *e.g.* the pathological enlargement of the coronoid process of the left *ulna*, apparently from an injury during life; the peculiar rounded shape and abrupt curvature of the ribs, analogous in their appearance to those of a carnivorous animal; Professor Schauffhausen supposes this malformation to arise from an unusually powerful development of the thoracic muscles. All these characters are compatible with the Neanderthal skeleton having belonged to some poor idiot or hermit, who died in the cave where his remains have been found. They are incompatible with the evidences which might be left in a Westphalian bone-cave of the remains of a normal healthy uninjured human being of the *Homo sapiens* of Linnæus.

Engis (*Belgium*).—Fig. 3.—This skull, which was found by Dr. Schmerling in the year 1833 in a cave, with the cave bear, cave hyæna, elephant, etc., and has since proved the *teterrima causa belli* of palæontologists from the days of Buckland and Schmerling down to our own days, exhibits a type of *cranium* which, if attention had not been speciallycalled to it, as that of an alleged contemporary of the cave bear and mammoth, would have been the last to attract the attention of a

* 'Medical Times,' Feb. 15, 1862.

craniologist. This most ordinary type exhibits a fairly-developed forehead, a full and high, but not shelving, occiput, supraorbital ridges not prominent, and, generally speaking, analogous to dozens of Indo-European crania. In the Nepâl collection in the British

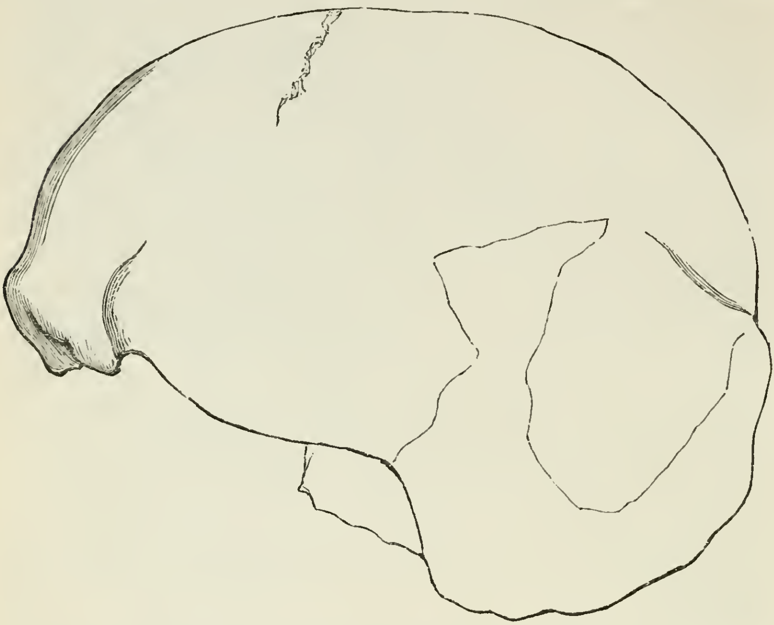


Fig. 3.—Human skull from Engis (scale ½ linear).

Museum there are several skulls which resemble the Engis cranium in their configuration. It is dolichocephalic, but does not approach to any of the boat-shaped (kumbecephalic) skulls which have been afforded to us from graves in Scotland of the early "Stone period."

Massat.—The remains from this bone-cave do not afford us any evidences which would lead us to distinguish their cranial type. Only a few teeth have been discovered associated with remains of *Felis spelæa*, *Ursus spelæus*, *Hyæna spelæa*, etc.

Plau (*Mecklenburg*).—Fig. 4.—The skeleton to which this skull belonged was found in silicious sand, six feet below the surface, associated with bone implements made out of the osseous remains of stag and boar. Dr. Schauffhausen says: "A very high antiquity was assigned to this grave, as it was wholly unprotected by any masonry, and afforded no trace of cremation having been practised, nor any implements of stone, clay, or metal." Similar arguments might be adduced in favour of the high antiquity of the soldiers buried at Inkerman, who, tossed into a pit naked or with a blanket round them, would afford no evidences of masonry, cremation, stone, or metallic implements. The cranial appearance of the skull is, however, truly remarkable, although it approaches very much to the configuration of the cranium from Montrose, to which I shall presently allude. It is brachycephalic, the occiput being high, and the supraorbital ridges well developed. The length from the glabella to the occiput is 6″ 5‴, the breadth across the parietal tubers 5″ 5‴. Dr. Schauffhausen states: "Notwithstanding the great similarity in the form of the forehead between this skull and that from the Neanderthal, the prominence of the supraorbital ridges in the latter is more marked, and they are completely continuous with the orbital

Fig. 4.—Human skull from Plau (scale ½ linear).

margin, which is not the case in the former. But the skulls are essentially distinguished by their general form, which in the one is long-elliptical, and in the other rounded." A portion of the upper jaw with the teeth, and the entire lower jaw, have been preserved, indicating that the Plau man was orthognathous. As in most of these cases, the sole chemical evidence of the antiquity of the Plau skeleton is, that "the bones are thick but very light, and adhere strongly to the tongue." More exact analysis of their component parts is unrecorded by Dr. Schauffhausen.

Aurignac (*Gascony*).—The human remains from this cavern, which were associated, but in a way not known, with those of *Elephas primigenius*, *Rhinoceros tichorhinus*, *Megaceros*, etc., after their discovery, fell into the hands of the mayor of Aurignac. Not regarding the interests of science, and in order to prevent the dissemination of any hypotheses on the subject amongst the Gascons, he carefully collected all the bones together, amounting to seventeen individuals, and caused them to be reinterred in the parish burial-ground. Eight years afterwards, "not even the sexton retained any recollection of the precise spot at which these human remains had been deposited in a common trench." Future palæontologists will rank Dr. Amiel, the mayor of Aurignac, with the trustees of the Ashmolean Museum, who destroyed the last specimen of the Dodo, in Oxford. His ignorance, or superstition, has deprived Palæontology of one of the most important links of evidence ever discovered. No information consequently exists of the appearance of the bones, as denoting the race to which they might possibly appertain.

Mewslade (*Glamorganshire*).—Fig. 5.—This cranium Professor Busk describes as "probably that of a female, found together with less perfect skulls and numerous other bones belonging to six or seven individuals of different ages, from sixty or seventy down to three or four years, in a narrow fissure in a limestone quarry at Mewslade in Glamorganshire, and *not improbably* of the same period as the

Fig. 5.—Human skull from Mewslade (scale ½ linear).

bones of animals, etc., found in the neighbouring caverns in Gower, which have been described by Dr. Falconer and others. This cranium is obviously of a wholly distinct type from that of the others, though still in some respects peculiar." The frontal region is elevated, the supraorbital ridge being only moderately prominent. The alisphenoid and the parietal join. The skull belongs markedly to the dolichocephalic type, and slightly reminds us of the Engis cranium.

Sennen (*Cornwall*).—Fig. 6.—In this cranium, which was discovered in a subterranean peat bog or forest, thirty feet below the present level of the sea, at Sennen, near the Land's End, Cornwall, and of which Professor Busk remarks that it "bears some resemblance to the Engis cranium of Dr. Schmerling," the dolichocephalic cha-

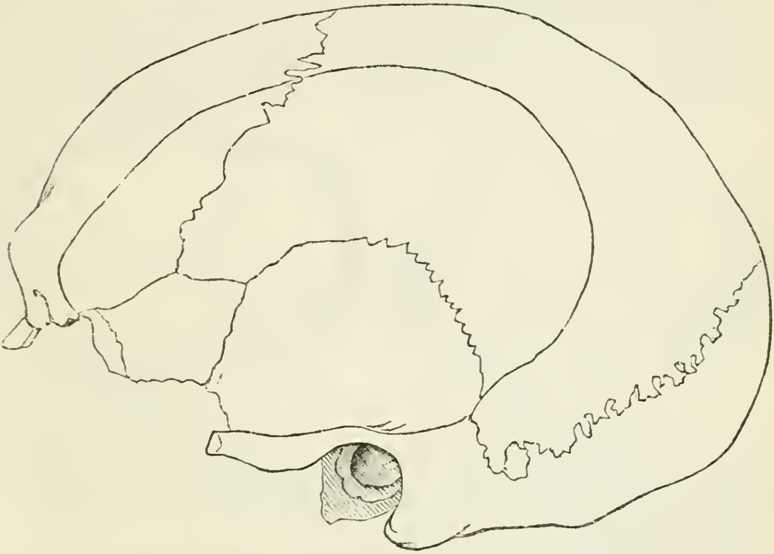


Fig. 6.—Human skull from Sennen, Cornwall (scale ½ linear).

racter is strongly marked. The frontal region is retrocedent; the occiput shelving backwards. The alisphenoid and the parietal bones join for a greater extent than in most Caucasian skulls. The supra-orbital ridges are less prominent than in the Plau, more so than in the Mewslade crania. The *meatus auditorius externus* is large; the zygomatic arch strong and powerful.

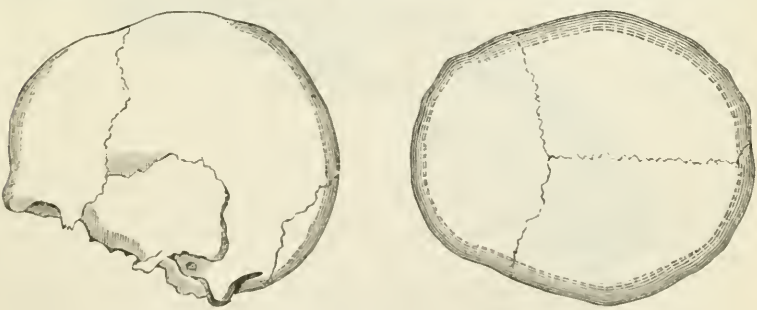


Fig. 7.—Human skull from Montrose (scale ¼ linear).

Montrose.—Fig. 7.—This, the most typical example of a British brachycephalic skull, was found in a tumulus, supposed to belong to the later part of the Stone period. In the words of Professor Wilson, it "is square and compact in form, broad and short, but well balanced, and with a good frontal development. The supraciliaries are moderately elevated."

Nether Urquhart (*Fifeshire*).—Fig. 8.—This is one of the *kumbecephalic* or boat-shaped skulls which were found in a cairn in Fifeshire in 1835. It is supposed to belong to the early part of the Stone period. This period might be called the protolithic (from

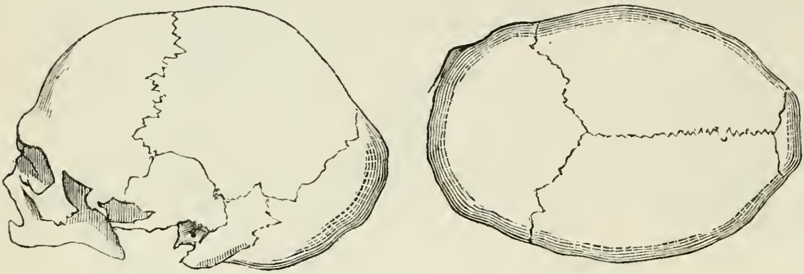


Fig. 8.—Human skull from Nether Urquhart (scale ¼ linear).

πρῶτος, first, and λίθος, stone). The long, narrow and shelving occiput, the retrocedent frontals, and the prominent supraciliaries, indicate the similarity of this skull to that from Sennen, to which I have already alluded.

The researches of Professor Wilson lead him to the result that the kumbecephalic (dolichocephalic) races in Great Britain antedated the brachycephalic races in time; those of Professor Nilsson, that the brachycephalic men in Scandinavia flourished before the dolichocephalic races.

Plymouth.—Fig. 9.—In this small portion of a cranium, "found in a limestone quarry at Plymouth, at a depth of about six feet

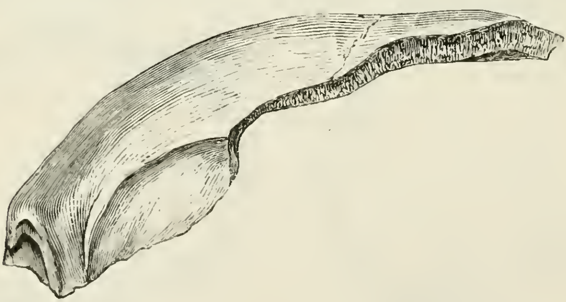


Fig. 9.—Human skull from Plymouth (scale ½ linear).

below the present turf," the retrocedence of the forehead is very remarkable. The supraorbital ridges project but slightly, and are discontinuous over the nasal bone. The fractured condition of the cranium precludes any observation on the form of the occiput or the length of the sphenoido-parietal suture.

East Ham (Valley of Thames).—Mr. Cresy, at the meeting of the Geologists' Association on April 7, 1862, exhibited this skull, as well as two others, of supposed less geological antiquity. The conditions

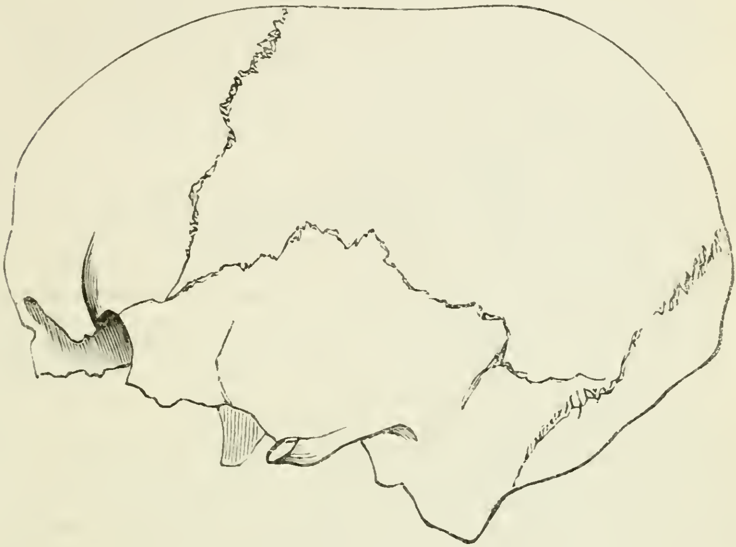


Fig. 10.—Human skull from East Ham (scale ½ linear).

under which it was found were detailed by him. The "skull was found in excavating for the foundations of the Northern Outfall Sewer, in East Ham Marshes, at a depth of fifteen feet below the surface, the strata being—

2 feet grass and mould.
5 ,, yellow clay.
5 ,, peat.
3 ,, sand and gravel in which it was found.
—
15 feet."

With it were discovered two "celts" chipped on the surface, excepting the trenchant edges, which were ground, and the lower jaw of a cetacean animal, which will form the subject of future remarks by Mr. Cresy. Having had the opportunity, through the kindness of Mr. Mackie, of examining this skull, I give the following table of measurements, taken with tape and rule in the ordinary manner:

	Inches.
Longitudinal diameter from between supraorbitals to inion	6⅞

	Inches.
Parietal diameter between parietal tubers	$5\frac{1}{4}$
Frontal diameter between anterior and inferior angles of parietal bones	$4\frac{3}{4}$
Vertical diameter from fossa between occipital condyles to top of skull	$4\frac{3}{4}$
Intermastoid arch from one mastoid to the other, over the calvarium	$14\frac{1}{4}$
Intermastoid line, measured in a straight line between the points of the mastoid processes	4
Occipito-frontal arch, measured by a tape on the surface of the cranium from the nasal suture to the posterior margin of the *foramen magnum*	14
Horizontal periphery, by a tape round the cranium, so as to touch the *os frontis* immediately above the superciliary ridges, and the most prominent part of the occipital bone	$20\frac{1}{8}$

In the above table, I have used the system of measurement proposed by Dr. George Williamson.*

It appears from the proportion of this (a female) skull, that the breadth was to the length as $7\frac{7}{29}$: 10, and that it was consequently "dolichocephalic." The type is oval, the frontal being rounded, with a flat calvarium, and the parietal tubers moderately developed. The occiput is oval, the inion being slightly protuberant; the lower half of the supraoccipital shelves gently downwards to the *foramen magnum*. The occipital condyles are flattened. The alisphenoid and the parietal join on both sides of the head, with small *ossa wormiana* intercalated in the suture. The frontal suture is obliterated. Above the interorbital space is a slight projection, possibly coincident with, though not necessarily an indication of the frontal sinus. Behind the coronal suture, the calvarium is slightly depressed, perhaps indicating the use of a constricting bandage compressing the cranium. From these characters it appears that no distinctive points can be predicted of this cranium, as differentiating it from the skulls of the existing individuals who inhabit the valley of the Thames. To this skull was adherent a small amount of fine mud, apparently of the same chemical constituency as the clay-bed of the river Thames or Lea. The whole of the animal matter was present in the skull, which did not adhere when applied to the tongue.

Borris (bed of Nore), Ireland.—The supraorbitals here are slightly more prominent than in the Blackwater, less so than in the Valley of the Trent skull. The lambdoidal suture is very complex, and developes many *ossa wormiana* on both sides. The fractured condition of the skull precludes any observation as to the junction of the parietals and alisphenoids, or as to the presence of a paroccipital tubercle. The opportunity of inspecting this skull at leisure has been afforded to me by Prof. Huxley.

* 'Observations on the Human Crania contained in the Museum of the Army Medical Department, Chatham.' 8vo. Dublin, 1857, p. 73.

Bed of Blackwater River, Armagh (Ireland).—In this skull, which has been kindly lent to me by Prof. Huxley, the alisphenoid and the parietal join on the right side; the apex, however, of the parietal impinges on the alisphenoid on the left: the supraorbitals are scarcely, if at all, prominent; the retrocedent frontal, and the calvarium sloping gently upwards to the centre of the parietal bone, repeat here the characters of the Borris skull and the skull from the Valley of the Trent. In the cast, the paroccipital tubercle is slightly prominent on the right side.

Valley of the Trent.—This skull repeats many of the characters of the Borris and Blackwater skulls, from which, however, it is markedly distinct. The alisphenoid and the parietal join on both sides. On the right side the jugular eminence is pronouncedly distinct, and indicates a well-defined paroccipital tubercle. The left jugular eminence is, however, broken away. The digastric fossa is deep; the inion is protuberant. Over each orbit is a ridge, discontinuous over the nasal suture, and which projects forwards. This contains, on each side, large, distinct, and well-defined supraorbital foramina. Along the sagittal suture is a slight elevation, or crest, analogous to that often observed in the Australian races. The low frontal bone reminds the observer forcibly of the Andaman skull,* which it does not exceed in regard to its frontal development.

One of the most important differences which the cranium of the *Troglodytes Gorilla* presents to the human skull has been defined by Prof. Owen (Osteological Catalogue of the College of Surgeons) to be the more backward position of the *foramen magnum*, and its more oblique plane in relation to the base of the skull in the Gorilla, than in man. The almost horizontal direction of the *foramen magnum* in the human species, co-related with the character (*situs erectus*) applied by the Linnæan definition to man, is modified in the Valley of the Trent skull, and such modification is in the direction of the inferior type. The angle made by a line drawn from the anterior to the posterior margins of the *foramen magnum*, with the plane of the basioccipital, is more oblique than I have observed in any human skull, and markedly more so than in the so-called "lowest" races of mankind, as *e.g.* the Australians and Andaman Islanders. This character, coupled with the powerful occipital spine, the ridged and crested surface of the lower half of the superoccipital, indicative of the action of powerful nuchal ligaments to keep the head from falling forwards, the presence of a "paroccipital" process for the firmer attachment of the *rectus capitis lateralis*, and the slightly more backward position of the occipital condyles, seem to indicate that an entirely erect position was not the normal attitude of the pre-historical contemporary of *Bos primigenius* in the Valley of the Trent.

The skull from the Valley of the Trent exhibits, on the right side of the upper half of the superoccipital bone, a partial retention of the suture dividing the *squama occipitalis* from the lower half of the

* Owen, Trans. Ethn. Soc. 1862.

superoccipital bone. This character, the "*os Incæ*," was first observed by Dr. Bellamy, in the skulls of the early Peruvians. Prof. Tschudi* considered it as a mark of the primeval distinction of the Peruvian race, the skulls of which, according to him, manifested this alleged "embryonic character" as in the lower mammalia. Morton observed it in a Chimu (called by him Chimuyan), and in a Cayuga skull. In the British Museum is a large handsome skull, belonging to the "Chincha" type, in which the interparietal bone is manifest. In Mr. Edward Gerrard's most useful and valuable catalogue, recently published, the locality is marked as from Pasadama (*i. e.* Pachacamac), near Lima.

In the collection of the Royal College of Surgeons, on No. 5711 (a Laplander), Prof. Owen remarks, "the suture between the exoccipital and supraoccipital is retained on the right side, and partially so on the left." Here, however, there are numerous Wormian bones in the lambdoidal suture. On No. 5390 (a New Zealander), he says, "the upper half of the supraoccipital has been developed as an interparietal from a separate centre, and has united by a complex dentated suture with the lower half of the supraoccipital." A similar conformation exists in a skull from the Roman burial-place at Felixstow, preserved in the Anatomical Museum at Cambridge,† and in the cranium of a Bengalee. The law which regulates the repetition of similar characters in skulls of nations aboriginally distinct is termed by Prof. J. Aitken Meigs,‡ of Philadelphia, "homoiokephalic representation." Analogous congenital varieties or imperfections may be seen in almost every ethnic type. Dr. Williamson has described them in the Albanian, Singhalese, Timmani, Kosso, Krooman, Fanti, Ashantee, Calabar, Burmese (Malay), and Esquimaux; whilst in the Limbu tribe from Nepâl, an instance has been described by Prof. Owen, in which the "interparietal" is divided into three distinct *quasi*-symmetrical portions. Dr. Spencer Cobbold has seen a true interparietal bone in a skull in the Edinburgh Museum; and I have recently observed it in a skull belonging to the Ethnological Society's collection, of which I am not yet satisfied as to the precise nation to which it belonged.

A cursory examination of the bones found with the human skull, at the Valley of the Trent, has afforded to me evidence of *Bos longifrons*, *Bos primigenius*, stag, wolf, goat, and horse. Some of the horn cores of *Bos longifrons* appeared to me to be more curved than usual, but the majority exhibited the normal form.

Heathery Burn Cave, near Stanhope.—I refrain intentionally from offering any remarks on the human remains discovered in this cave, as the geological conditions under which they were found have been ably detailed by Mr. Elliott, and the human skull will be described by Prof. Huxley.§ The condition of the mammalian remains from

* Rivero and Tschudi, 'Antiguedades Peruanas.' † Davis and Thurnam, p. 29.

‡ Meigs, 'Description of a Fragmentary Human Skull from Jerusalem.' 8vo. Philad. p. 279.

§ See p. 201 of this number.—Ed. Geol.

the cave at Stanhope does not indicate a high geological antiquity. Although a great range of variation is undoubtedly observable in the amount of cartilaginous matter retained in the bones, still none adhere to the tongue with the same firm degree of fixation as the hyæna remains, *e.g.* from the Kirkdale Cavern. Moreover, all the remains which I have myself examined indicate animals, as the ox, horse, otter, badger, water-rat, goat, roebuck, which are still found in England, or which, as the wild boar, have become extinct during a late historical period. The presence of bronze remains, analogous to those used by the early Scandinavians, however, would not leave us to infer even a high historical antiquity to these remains. The rate at which the stalagmitic formation—in this case extending to as much as eight inches of depth—might have been deposited, may possibly afford us a means of estimating the age more accurately. Practical geologists alone can determine this. The fragmentary condition of many of the bones indicates the possibility of their having been the *débris* of repasts. Some small hollow bones have been split longitudinally, perhaps to extract the marrow for the use of man. Another bone bears the impress of two small teeth on one, and another tooth on the other side: such small apertures or impressions could have been made with facility by the acuminate cuspid teeth of the otter, whose jaw is found in the cave. Not so by the tooth of the badger, also found in proximity, whose powerful tuberculate molars would not have punctured the bone, but crushed it; scarcely by the tooth of the water-rat (*Arvicola amphibia*), whose scalpriform teeth would have eroded the surface of the bone without drilling an aperture. One of the punctures is squared, and of the same dimensions as the crown of the upper incisor of the amphibious rodent. However, the distance between the two most prominent apertures in the bone accords with the distance between the two most salient cusps of the premolar and molar series in the jaw of the otter, which, deprived of fish, would have been glad to partake of a more nutritive food.

Otter (*Lutra vulgaris*). We have evidence of the fractured part of a skull of this species, which, as well as a ramus of under jaw, has been preserved. The jaw is nearly perfect, but the only teeth which still remain in it are the canine, the second, *p* 3, and the third, *p* 4, premolars. Empty sockets alone indicate the spots where *p* 2, *m* 1 (the sectorial tooth), and *m* 2 have been. The jaw, as well as the fractured cranium, is fresh, and contains much of the recent animal matter.

Badger (*Meles taxus*). The large left ramus of jaw (specimen No. 50), by the characteristic form of its first true molar, is manifestly that of the existing badger. In it the molar series is perfect, with the exception of *p* 2, the molar series, in place, being *m* 2, *m* 1, *p* 4, *p* 3, and *p* 1. The apex of the canine, as well as the crown of *m* 1, is much worn, indicating the age of the individual to which the jaw belonged. The incisor series is absent, and the ascending ramus of the jaw, coronoid, condyle, and angle, are broken away.

Goat (*Capra hircus*). The left ramus of the jaw of goat, from the Stanhope caves, exhibits *m* 2, *m* 3, and *p* 2, in place, the sockets of *m* 1 and of *p* 3 being left broken in the alveoli, and *p* 1 being absent. In another fragment also of left ramus *p* 2 and *p* 3 are left *in situ*.

Roebuck (*Cervus capreolus*). The broken fragment of the left ramus of the under jaw of *Cervus capreolus* has lost all the teeth except the second and third premolars. These exhibit the characteristic sculpturing of Cervus, and present a marked distinction to the caprine bones from the same locality. The second premolar is divided into two lobes, the anterior being the smallest, and separated from the hinder lobe by a notch on the inner side of the crown; the posterior lobe is subquadrate, and exhibits two islands of enamel, of which the hinder is the larger, and transverse to the axis of the jaw. The third premolar, approaching nearer to the bicrescentic form of the true molars in Ruminantia, is again divided into two lobes, by vertical depressions on both the outer and inner sides. The anterior lobe is here the largest, and developes a prominent cusp on the inner side of the tooth. In it the enamel-island is crescentiform, though not extending so far back as the lateral notch. The transverse island, in the posterior cusp, is more than double the length of its representative in *p* 2.

The distal end of the metatarsal of a ruminant has been exposed to the action of fire—the end being charred. Evidence of the erosive action of the teeth of some carnivore is present on a vertebra, which has been gnawed to such an extent as to obscure its specific characters.

Hog (*Sus scrofa*). Three large canine teeth of the wild boar, one of which is partially blackened, and the extremity of another canine, indicate the existence of the *Sus scrofa ferus* in the Durham bone-cave. Another more friable evidence consists of the blackened symphysis of a young hog, of which the right canine is in place, and all the deciduous teeth absent. In the jaw, the germ of *p* 4 appears, which has not yet appeared above the alveolus.

Horse (*Equus caballus*). The unquestionable evidence of the existence of the Equus in the Heathery Burn Cave rests upon the discovery of a "corner nipper" (*i* 3) of the upper jaw, right side of an old horse, aged about 16 years.

Water-rat (*Arvicola amphibia*). The numerous evidences of the presence of this elegant-skulled little rodent are so perfectly preserved that, though fragile, the incisor teeth retain their typical yellow colour. The fore-parts of two skulls, the left ramus of a lower jaw, and two separate small incisor teeth have been preserved; and as none of the animal matter has been removed, great doubt exists whether any great lapse of time has taken place since their being imbedded in the deposit. It is not stated at what depth these remains were found, but there is no stalagmite adhering to them, and their appearance, like that of the two copper halfpence (temp. Geo. II.), is very recent. Mr. J. Elliott ('Geologist,' vol. v. p. 169) has told us "the *coins were under very little cover*, and might have been imbedded very recently." The exact depth is, however, unrecorded.

The large flat plate, from (I presume) the bed of the watercourse, in the Heathery Burn Cave, is a most interesting relic. Although unquestionably modern, it is covered to the depth of $\frac{1}{3}$ inch with a thick deposit of fish-bones, of which the centra, neural arches, and hæmal arches of the vertebræ can be observed, and amongst which some bones, possibly those of small frogs or tadpoles, may be detected. All these are in a very friable state.

Etruria.—In the osteological department of the British Museum are four skulls, of presumed high historical antiquity, which were derived from caves in Etruria. I give the following table of their measurements, taken in the same way as I have measured the East Ham skull. This table is necessarily defective, as in the skulls marked I. M. N. and +, the apical extremities of the mastoid processes are broken away, and the horizontal periphery of the skull marked + cannot be computed exactly, by reason of the left squamosal having posthumously bulged out from the parietals.

Measurements.	Etrurian. O	Blackwater.	Etrurian. I.M.M.	Etrurian. I.M.N.	Borris.	Valley of the Trent.	Etrurian. +
Longitudinal diameter	$6\frac{3}{4}$	$7\frac{1}{4}$	7	$7\frac{1}{2}$	$7\frac{1}{2}$	$7\frac{1}{4}$	$7\frac{1}{2}$
Parietal diameter	$5\frac{3}{4}$	$5\frac{7}{8}$	$5\frac{1}{8}$	$5\frac{1}{4}$	$5\frac{1}{4}$	5	5
Frontal diameter	5	$4\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{2}$	—	$4\frac{1}{4}$	$4\frac{5}{8}$
Vertical diameter	$4\frac{1}{2}$	$5\frac{3}{4}$	$4\frac{3}{4}$	5	—	$5\frac{3}{8}$	5
Intermastoid arch	$14\frac{3}{4}$	$14\frac{1}{4}$	$14\frac{3}{4}$	$14\frac{1}{2}$	—	$14\frac{1}{2}$	$14\frac{1}{2}$
Intermastoid line	$4\frac{3}{8}$	$4\frac{1}{2}$	4	$4\frac{1}{2}$	—	4	$4\frac{1}{8}$
Occipitofrontal arch	$14\frac{1}{4}$	$14\frac{1}{2}$	$14\frac{1}{2}$	$14\frac{1}{2}$	$15\frac{3}{4}$	14	$15\frac{1}{4}$
Horizontal periphery	$21\frac{1}{8}$	$20\frac{3}{4}$	20	$20\frac{1}{2}$	21	20	$20\frac{5}{8}$
Proportion of breadth to length, the latter being estimated as 10	8·518	8·103	7·321	7	7	6·879	6·666

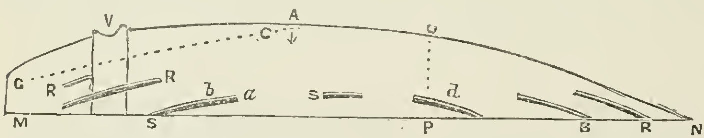
In I. M. M. and I. M. N. the occiput is globular, and shelving gently downwards. In + it is full and oval, the lower half of the supraoccipital being flattened. No undue prominence of the supra-orbital ridge, or of the paroccipital tubercles, is observable. Small *ossa wormiana* are present in the lambdoid suture of I. M. M., but in I. M. N. the sutures are obliterated; nor does + exhibit any peculiarity in this respect. The frontal suture, however, in I. M. M. is present. The inion is distinctly marked in I. M. M. and in +; not so, however, in I. M. N. In all three skulls the alisphenoid and parietal join. A slight depression of the vertex is indicated behind the coronal suture in the three skulls, and especially in I. M. M. No history of the specimens has been preserved, nor is there any geological or antiquarian evidence demonstrating their antiquity.

The contrast between the brachycephalic skull marked O, and the dolichocephalic one marked +, from the same locality, is significant.

Switzerland.—Mr. Lubbock, in his memoir on the subject, has told us "Human bones occur in the Pileworks (*Pfahlbauten*) but very seldom, and may no doubt be referred to accidents, especially as we find that those of children are most numerous. One mature skull was, however, discovered at Meilen, and has been described by Professor His, who considers that it does not differ much from the ordinary Swiss type.* And while his work was in the press, M. Rütimeyer received from M. Schwab four more skulls, two of which were obtained at Nidau Steinberg, one at Sutz, and one from Biel." Mr. Lubbock proceeds to say: "Whether the Drift race of men were really the aboriginal inhabitants of Europe, still remains to be ascertained. M. Rütimeyer hints that our geographical distribution indicates a still greater antiquity of the human race." No general statement of facts is, however, adduced in support of M. Rütimeyer's theory, which the negative evidence, which proves that human bones are as capable of preservation as those of mammalia, tends to refute until observation and demonstration shall establish the greater antiquity of man.

A human cranium belonging to the first age of iron, from Tiefenau, exhibited exactly the same profile as the cranium from Sanderumgaard. M. Morlot states that the height of the Swiss cranium is identically the same, and the length is a little (5 *millimètres*) longer than that of the Danish cranium. (Morlot, 'Etudes Géologico-Archéologiques,' p. 317.)

Objects of human art have been found at various depths in a tumulus near the Tinière rivulet, which flows into the Lake of Geneva near Villeneuve. In order that my readers may understand more clearly M. Morlot's reasoning, I transcribe his diagram and references.



ACTUAL SECTION OF THE "CONE DE DÉJECTION TORRENTIELLE DE LA TINIÈRE."

From A. Morlot, 'Leçon d'ouverture d'un Cours sur la haute Antiquité, fait à l'Académie de Lausanne en Novembre et Décembre 1860.' 8vo. Lausanne, 1861.

R. *Bed of the Roman age.*

B. *Bed of the Bronze age*, date 3000 to 4000 years ago.

S. *Bed of the Stone age*, date 5000 to 7000 years, in which were found, at *a*, a piece of pottery; at *b*, a human skeleton, which appeared to have been laid in a tomb, and of which the very small, round, and remarkably thick head presented the Mongolian or Turanian "brachycephalic" type, strongly marked; at *d*, many frag-

* Dolichocephalic?

ments of very coarse pottery, much charcoal, and broken pieces of the bones of various animals—a proof that man had inhabited that precise spot.

A. *Central axis of the cone,* transversely bisected by the railway. It is here that the torrent flowed in ordinary times, before the dykes had been constructed.

C C. *Surface of the cone,* when the torrent was commenced to be dyked. This line is, to a certain extent, ideal; all the others are real, and have been actually observed as they are represented in the section.

M N. The iron road.

V. Bridge acting as aqueduct to the torrent which crosses the railway.

O P N. In this space exclusively all those distances are included which have served to establish chronological calculations. These distances, often repeated, are capable of being taken here very exactly; they can be considered as exact almost to half an inch.

The section has been interrupted at M, because it became indistinct here. Its southern extremity was complete in every relation.

Kjökkenmöddings (*Denmark*).—Numerous human skeletons from the ancient deposits of Denmark, in which the remains of extinct animals, with one exception (*Bos primigenius*) have not been found, have been afforded to us. The skulls are brachycephalic, and possess well-defined supraorbital ridges. M. Morlot says "that their front teeth did not overlap as ours do, but met one another, as those of the Greenlanders of the present day. This evidently indicates a peculiar manner of eating." The value of this assumption could only be estimated by the illustration of a drawing, showing in what way such close juxtaposition of the incisor teeth was effected. This evidence, however, is not given to us, and those who are acquainted with the range of dental variation in man, however they might consider a conformation of this sort indicative of a peculiar description of food, will hardly affirm that the builders of the tumuli had "a peculiar manner of eating." M. Morlot, although he quotes the Greenlanders, Egyptians, and other nations as exhibiting the same dental peculiarity, the incisors being worn away so as functionally to resemble molars, is evidently not aware of the fact that this conformation has been observed even amongst British sailors, and that it is due solely to the triturating action of the hard substances used by them as food. In the sepulchral edifices of the early Danes, carefully constructed of large hewn stones, M. Morlot has discovered numerous crania, of which, he says, the type can be established. "It is a small head, remarkably rounded in every way, but with a rather large facial angle, and a forehead which does not bear the mark of a slightly-developed intelligence. This type reminds one of that of the Laplander, but it cannot be precisely affirmed to be identical with it." One from Sanderumgaard, of the Iron period, in the island of Fyen, is dolichocephalic, with a slightly retrocedent frontal. Practical cranioscopists are aware that the range of variation in the skulls of the Indo-European races is such as to exhibit many crania of these two types amongst the existing races of Europe and Asia. Palæontologists are under a lasting debt of obligation to M. Morlot, who has, by his researches on the later geological strata of Switzerland, furnished us with an almost inexhaustible mine of information on the contemporaneity of man with the extinct animals at both the Kjökkenmöddings and Pfahlbauten.* Human osseous remains have not been demonstrated in the Kjökkenmöddings themselves, according to the testimony of the latest observers of these shell-deposits.

The broad ground may be admitted, that the earliest Briton skulls generally exhibit a supraorbital projection, which attains in its development, however, nothing like the size of the ridge in the Neanderthal cranium. The majority of the British, Hibernian, and Caledonian skulls figured by Messrs. Davis and Thurnam† exhibit a large supraorbital ridge. This character is also present in a few of the Saxon skulls.

The supraorbital development of the Briton skull from Ballidon Moor‡ is fully equal to that of the Engis cranium. The Neanderthal skull, however, admittedly stands *sui generis*.

The Museum of Natural History at Copenhagen contains skulls of the "Stone Period" in Denmark with an excessive supraorbital projection.

Aboriginal American races of high antiquity often exhibit a large supraorbital development. This may be seen on examining Morton's§ plates of the Peruvian from Pachacamac ("Temple of the Sun"), plate 11A, and the skulls of mound-builders from the Upper Mississippi (plate 52), Tennessee (plate 55), and Steutenville, in Ohio (plate 68).

The frontal development of the Australian race, accompanied by an absence of the frontal sinus, has been frequently noticed, and several Australian skulls have the supraorbital ridge overhanging the origin of the nasals to the degree shown in the skulls from Engis and the Valley of the Trent.

Supraorbital development in the Negro is far from being a constant character. It is undoubtedly present in many of the lower Negroes, but I have now before me a skull from Ashantee which exhibits less supraorbital development than many of the skulls from the "Stone period" in Denmark.

In India, the range of variation offered by the Hill-tribes of Nepâl exhibits the supraorbital ridge under a variety of aspects. The low-caste individuals, perhaps of all nations, have a greater tendency to repeat this character than the more elevated types. In Europeans,

* A. Morlot:

1. 'Leçon d'ouverture d'un Cours sur la haute Antiquité, fait à l'Académie de Lausanne en Novembre et Décembre 1860.' 8vo. Lausanne, 1861.

2. 'Remarques sur les formations modernes dans le Canton de Vaud.' (Bulletin de la Société Vaudoise des Sciences naturelles, tome v. No. 40.) 8vo. Lausanne, 1857.

3. 'Études Géologico-Archéologiques en Danemark et en Suisse.' 8vo. Lausanne, 1860. (Bulletin, etc., tome v. no. 46.)

4. 'On the Post-Tertiary and Quaternary Formations of Switzerland.' 8vo.

5. 'Recherches sur les Habitations lacustres des environs d'Estavayer,' par M. Biot de Vevay et Henri Rey, rédigées par M. Morlot. (Extrait des Mémoires de la Société des Antiquaires de Zurich, tome xiii.) 4to.

† 'Crania Britannica.' 4to and folio. London: 1856.

‡ Loc. cit.

§ 'Crania Americana.' Philadelphia: 1839. In a Pachacamac skull before me there is a very slight supraorbital development.

however, of high intellect this conformation may frequently be remarked; and I have observed it in more than one person with whom it was correlated with a high degree of mental ability.

The words of Professor Owen, applied to the Nepâl crania, are also applicable to the remains from the Stone period. "There are not more than two or three skulls in the entire series which would have suggested, had they been presented to observation without previous knowledge of their country, that they belonged to any primary division of human kind distinct from that usually characterized by craniologists as Caucasian or Indo-European; the majority might have been obtained from graveyards in London, Edinburgh, or Dublin, and have indicated a low condition of the Caucasian race. . . . They present varieties in the proportion of length and breadth of cranium, in the development of the nasal bones, in the divarication or prominence of the malar bones, in the shape of the forehead, in the degree of prominence of the frontal sinuses and projection of the supraciliary ridge, which would be found perhaps in as many promiscuously-collected skulls of the operatives of any of our large manufacturing towns, and which would be associated with corresponding diversities of features and physiognomy."*

The range of variation offered by the above skulls (the Neanderthal cranium excepted) is, on the whole, not greater than between a large series of the skulls of any given district—as, *e.g.*, Nepâl. Neither in the size of the supraorbital ridge; the extent of frontal development; the form of the occiput, whether shelving, vertical, or globular; the persistence of an interparietal bone; the presence or absence of a sphenoido-parietal suture; the position of the condyles; the development of sagittal or lambdoidal crests; the size, shape, or position of the styloid or vaginal processes—have any of those differences which so prominently characterize the *Homo sapiens* been departed from, nor any of the simial features superadded or retained as embryonal characters; nor have the latest published demonstrations of the anatomical characters of these ancient crania by the ablest advocates of the hypothesis of direct selective transmutation afforded us any satisfactory evidence to break down the broad bridge of demarcation which still separates us from the inferior animals.

The researches of Professor Steenstrup and others have led to the proposition of a series of periods, as exhibited in the annexed table, in which the propositions put forth by the advocates of the excessive antiquity of man are set forth in a tabular form. Direct contemporaneity of *e. g.* the denizens of the Kjökkenmöddings with the Natchez mound-builders is not inferred. "It would have been very much better for geology if so loose and ambiguous a word as 'contemporaneous' had been excluded from her terminology, and if in its stead some term, expressing similarity of serial relation and excluding the notion of time altogether, had been employed to

* Owen, 'Report on a Series of Nepâlese Skulls.' Transactions of the British Association, 1859.

denote correspondence in position in two or more series of strata," * and Professor Huxley uses the term *homotaxis* as expressing such relation.

Trees. Denmark.	Weapons.	Skulls. (Denmark.)	Instances.
Beech.	Workers in Iron.	Dolichocephalic.	
Oak.	Workers in Bronze.	Dolichocephalic.	Switzerland.
Pine.	Hatchets not chipped, but ground in Stone.	Brachycephalic.	Switzerland. Kjökkenmöddings. Natchez.
	Hatchets not ground, but chipped in Stone.		Somme Valley.
	PLIOCENE.		
	MIOCENE.		
	EOCENE.		

It has been further sought to show, that, as in Denmark and some other localities, a regular scale of division of the humatile strata into beech, oak, and pine-producing deposits prevails, each respectively coincident with iron, bronze, and stone remains, that an analogous distribution in time prevailed during the deposition of the extra-European humatile strata. Neither observation nor analogy, however, demonstrates this assumption. In the whole American continent, although we have the chipped flints and celts from Natchez and Chiriquí,† the obsidian knives from Mexico, and the arrowheads from Tierra del Fuego, the copper and gold implements from Peru and Chiriquí, the American mind never devised the plan of smelting iron from the ore, and applying the metalliferous residue to a useful purpose. The so-called "Iron Age" never existed in America.

The division of human crania into "brachycephalic" and "dolichocephalic" originated with the late Professor Retzius. Like the arbitrary and conventional divisions of other anthropologists into "orthognathous" and "prognathous," it was convenient as affording easy and intelligible descriptive terms for crania of diverse races. As a test of distinction of race, however, it is an insufficient mark of distinction. The supporters of the theory have based on it the following classification.‡

* Huxley, Address to Geological Society, 21st February, 1862.

† W. Bollaert and C. C. Blake on Antiquities from Chiriquí: Ethnological Society, March 18, 1862.

‡ On Fossil Man. Royal Institution. February 7, 1862.

"As types of these two varieties of crania, Professor Huxley adduced the West Coast African negro and the Turk. The typical cranium of the West Coast African negro is long and narrow, its transverse measurement being only six or seven tenths of the longitudinal, while the side to side diameter of the Turk's skull is as much as eight or nine tenths of the fore and aft measurement. The facial angle of the skulls also was different, owing to the projection of the jaws in the negro: the dolichocephalic skull was prognathic, while the brachycephalic skull was orthognathic. The most striking developments of these diversities were associated with the greatest differences of climate and situation. If a line be drawn from the centre of Russian Tartary to the Bight of Benin, the north-eastern extremity of the line would represent the centre or pole of the brachycephalic orthognathic variety, the south-western would be the centre of the dolichocephalic prognathic type. The centre of Russian Tartary was distinguished by an arid climate and great diversities of heat and cold, and presented the strongest contrast with the hot, moist, reeking swamps of the Western Coast of Africa. Now, in whatever direction we diverge from these dolichocephalic and brachycephalic centres, we find the type beginning to fade and to pass into the opposite. Thus, diverging from the brachycephalic pole, if we pass eastward into China, we notice the population becoming more dolichocephalic and prognathic; if we travel northward to the Aleutian Islanders, Esquimaux, and Greenlanders, we observe them more or less long-headed as compared with the Tartar type. The same divergence of type is seen on leaving the dolichocephalic centre; the peculiarities of the Western African cranial conformation gradually subside and approach in proportion the other type. Another line drawn across the centre of the former from the British Islands to India would mark a population whose skulls may be said to be oval, presenting a medium between the dolichocephalic and brachycephalic conformation." The question was then raised "whether the distribution of cranial forms had been the same in all periods of the world's history, or whether the older races, in any locality, possessed a different cranial character from their successors."

The induction that, on the whole, the brachycephalic type of cranium is more ancient than the dolichocephalic is capable only of a limited application. The skulls from Sennen, Plymouth, and Mewslade, said to be of antiquity transcending human historical records, all belong, as Professor Busk has stated, to the dolichocephalic type. If brachycephalic-skulled men existed before these, their remains have not been vouchsafed to us, in England at least. In the Continent, on the contrary, the Engis skull, said to be "the oldest relic of man on record," exhibits a dolichocephalic type. So does the Neanderthal skull, "the lowest in rank of any human being," exhibit, as well as can be ascertained from its fragmentary state, a long-headed or dolichocephalic type. These two types, therefore, "the oldest" and "the most degraded," according to the preconceived theory, belong to the so-called modern or dolichocephalic type, said to be coeval with the bronze and iron periods of man. So far their craniological nature *per se* fails to demonstrate their antiquity.

General biological analogy would not lead us to suppose that short-headed races of men first existed in this planet. We almost invariably find the "lowest" races of animals first. The "dark races of man,"* comprehending the Negros and Australians, are the lowest in our classification. They, if any, offer most affinity to the anthropoid apes. They are dolichocephalic. It would be far more consonant with analogy to suppose that the "dark races" once stretched over the tropical regions of the globe, and have left their modified descendants in Africa, Australia, and the Andaman Islands,† long previous to the introduction, origin, or derivation of the lighter races of the Old World, than to infer the existence of a supposititious race of short-headed men with or without simial supraorbital ridges, who flourished over the whole earth (America inclusive) antecedent to historical time. Speculation on this subject must be checked till we know what are the most ancient crania of the autochthonous tribes of the earth. In America, the mound-builders of the Mississippi valley are possibly the most ancient aborigines of North America. They are certainly brachycephalic to a degree transcending the existing American races. But the modern Quichua skull‡ (often termed Inca) is almost as short-headed, and the Quichua race has not the slightest claim to ethnological antiquity. Antecedent to the Quichua races, the "Flat-heads" of Titicaca (not satisfactorily identified with the Aymarás) who peopled Bolivia and Southern Peru for ages of unrecorded duration, even giving due allowance for distortion by artificial pressure, exhibit a long-headed or dolichocephalic type. A plausible hypothesis has even been mooted, that the Titicacan Flat-heads distorted their crania, with a view to perpetuate the remembrance of the dolichocephalic character of their ancestors. Retzius has attempted to identify the "Ancient Peruvians" of Morton, and the so-called "Huancas" of Tschudi, with the eastern dolichocephalic races of South America. This writer by no means coincided with those authors who consider the brachycephalic mound-builders of Mississippi as the remains of the typical American stock. He pointed out that in the eastern part of the American continent, from north to south, the dolichocephalic type predominated. The remains from the Brazilian bone-caves, described by Castelnau and

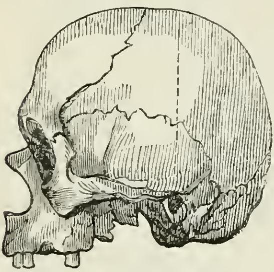


Fig. 12.—Mississippi mound-builder.

* Knox. Races of Men.

† Possibly in Ceylon, according to Mr. Brayley, F.R.S.: Medical Times, May 10, 1862.

‡ *Vide* Ethnological Society's Transactions, May 6, 1862, for my paper "On the Cranial Characters of the Peruvian Races."—C.C.B.

Lund, with retrocedent and possibly flattened crania, are dolichocephalic, and, according to Retzius, represent the primæval population of Brazil. Whether the flattening of their skulls was artificial or natural, may well be doubted. If natural, the succession of crania in Bolivia, Eastern Brazil, and Peru, would be as follows:—

1st. Natural Dolichocephali.
 Brazilian bone-caves.
 Oldest builders of Tia-huanaco (?).
2nd. Artificial Dolichocephali.
 Titicacans, Aymarás.
3rd. Artificial Brachycephali.
 Pachacamac, Quichuas, Incas, Atacamans.
 Changos.

The mounds termed *Koorgan* or *Bongor* in the Government of Tomsk, of which the antiquity is unascertained, containing brachycephalic skulls, afford no evidence of bronze or chipped stone implements. "The weapons and other objects found by MM. Meynier and d'Eichthal, in the tumuli, are either of bone or iron; the ornaments are of bone, melted silicate, polished quartz, or copper; there were, moreover, in one of the tumuli fragments of pottery; in another the remains of a wooden vessel. All the tumuli, without exception, had some remnants of iron tools or weapons, but none of bronze, the metallic ornaments found being cast in copper, exactly like all others our travellers have met with in Siberia in the collections of dilettanti. The cranium bears in all the skeletons strong marks of relationship with those which Retzius has designated under the name of 'Brachycephali,' their chief feature [*sic in orig.*] being the rectangular form of the orbital cavity, a form common to all Mongolian races. MM. Meynier and d'Eichthal are, nevertheless, inclined to believe that several different kinds of tumuli must be distinguished in Siberia, and that it would be premature to consider all these tombs as pertaining exclusively to a single race."*

Supporters of a derivative hypothesis of the human race from existing species of anthropoid apes have drawn a parallel between the dolichocephalic chimpanzee, and the dolichocephalic negro of Western Africa, and also between the brachycephalic oran-outan of Borneo and the brachycephalic Malay of the same locality. Ethnic centres of specific dispersion in time have been inferred from this geographical distribution. The remarkable alleged coincidence of the long-headed ape with the most long-headed man, and the short-headed ape with his short-headed human representative, and inferred descendant, certainly seemed a fact which might lead anthropologists to admit a possible transmutation. Reference, however, to the simple facts of the case gives a totally different aspect to this surmise. When we examine the skulls of the young oran-outan and chimpanzee, side by side, before their typical characters have been masked by superadded peculiarities connected with their functional require-

* Comptes Rendus, Acad. Sciences, 1862.

TABLE SHOWING THE ASSOCIATION OF THE EARLIEST EVIDENCES OF THE HUMAN RACE WITH THE REMAINS OF EXTINCT AND RECENT MAMMALIA.

Fossil species in italics. Bones ×. Works o. Pliocene Mammalia †. Pleistocene ‡. Domesticated Animals ¶.

	Neanderthal.	Engis.	Abbeville.	St. Acheul.	St. Roch.	Grenelle.	Massat.	Plau.	Aurignac.	Hoxne.	Brixham.	Kent's Hole.	Gray's Inn Lane.	Mewslade.	Sennen.	Montrose.	Nether Urquhart.	Plymouth.	Valley of the Trent.	Heathery Burn.	Switzerland.	Maccagnone.	Kjökkenmöddings, etc.	Wookey Hole.
Man	×	×	o	o	o	o	o	×	×	o	o	o	o	×	×	×	×	×	×	×o	×o	o	o	o
Felis spelæa			×			×			×			×										×		
Ursus spelæus‡		×	×						×		×	×										×		×
Ursus priscus												×												
Hyæna spelæa‡		×	×						×		×	×										×		×
Machairodus latidens†												×												
Machair. meganlereon†												×												
Bos primigenius‡			×	×	×		×?			×	×								×		×	×	×?	×
Bos longifrons‡																			×		×			
Bos frontosus (?)‡																					×		×	
Bison priscus‡						×			×?												×			
Ovibos moschatus‡																								
Elephas primigenius‡		×	×	×	×	×			×	×?		×	×											×
Elephas antiquus†				×	×																	×		
Rhinoceros tichorhinus‡		×	×		×				×		×	×												×
Rhinoceros leptorhinus†																								×?
Hippopot. major†					×							×										×		
Equus fossilis		×	×	×	×	×				×	×	×												×
Cervus megaceros‡							×		×			×							×			×		×
Cervus strongylocerus												×												
Cerv. pseudovirginianus							×																	
Cervus Somonensis‡			×	×	×																			
Cervus Guettardi																								×
Cervus Bucklandi																								×
Cervus tarandus			×						×	×?	×	×												×?
Cervus elaphus								×	×			×							×		×		×	
Cervus alces																					×			
Cervus capreolus									×			×								×	×		×	
Cervus dama																					×			×?
Sus scrofa¶								×	×											×	×	×	×	
Phoca gryphus																							×	
Lutra vulgaris																				×	×		×	
Canis lupus									×			×									×		×	×
Canis vulpes									×			×									×		×	×
Canis familiaris¶																					×		×	
Felis catus¶									×			×									×		×	
Felis lynx																							×	
Mustela putorius									×			×									×			
Mustela erminea												×									×			
Mustela martes																					×		×	
Mustela foina																					×			
Sorex vulgaris												×												
Erinaceus europæus																					×		×	
Hypudæus amphibius												×								×			×	

TABLE SHOWING EARLIEST EVIDENCES OF HUMAN RACE, &c.—*continued.*

	Neanderthal.	Engis.	Abbeville.	St. Acheul.	St. Roch.	Grenelle.	Massat.	Plau.	Aurignac.	Hoxne.	Brixham.	Kent's Hole.	Gray's Inn Lane.	Mewslade.	Sennen.	Montrose.	Nether Urquhart.	Plymouth.	Valley of the Trent.	Heathery Burn.	Switzerland.	Maccagnone.	Kjökkenmöddings, etc.	Wookey Hole.
Capra Ibex	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...
Capra hircus¶	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	×	...	...	...
Antilope rupicapra	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...
Ovis aries¶	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...
Ursus arctos	...	...	...	...	...	...	...	...	×?	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...
Meles taxus	...	...	...	...	...	...	...	...	×	...	...	×	...	...	...	...	...	...	...	×	×	...	...	...
Mus sylvaticus	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...
Lagomys spelæus	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...
Lepus timidus	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	×	...	...	...
Rhinolophus f. equinum	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...
Arvicola agrestis	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...
Arvicola pratensis	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...
Lepus variabilis	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...
Lepus cuniculus	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...
Castor fiber	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	×	...
Sciurus vulgaris	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...
Equus caballus¶	...	...	...	...	...	...	...	×?	×	...	...	×?	...	...	...	...	...	...	×	×	×	...	...	...
Equus asinus¶	...	...	...	...	...	...	...	...	×	...	...	×	...	...	...	...	...	...	...	...	×	...	...	...

The above table may be epitomized as follows:—

The dolichocephalic skulls are here marked D; the brachycephalic, B.

Locality.	No. of extinct species.	No. of recent species.	Total.
Neanderthal. D	0	0	0
Engis. D	5	0	5
Abbeville	8	1	9
St. Acheul	5	0	5
St. Roch	7	0	7
Grenelle	4	0	4
Massat. ?	7	1	8
Plau. B	0	3	3
Aurignac. ?	7	12	19
Hoxne	3	1	4
Brixham	5	1	6
Kent's Hole	12	19	31
Grays Inn Lane	1	0	1
Mewslade. D	0	0	0
Sennen. D	0	0	0
Montrose. B	0	0	0
Nether Urquhart. D	0	0	0
Plymouth. D?	0	0	0
Vale of Belvoir. D	3	4	7
Heathery Burn. D	0	7	7
Switzerland. B	4	27	31
Maccagnone	7	1	8
Kjökkenmöddings, etc. B	2	14	16
Wookey Hole	10	4	14

ments, we see that the young oran-outan, gorilla, and chimpanzee have the transverse diameter of the skull proportionately equal,* and that the apparent length of the head in the chimpanzee is produced by the greater development of the supraciliary ridges than in the oran-outan. In the young gorilla, also an African ape, coincident in its geographical distribution with races of dolichocephalic negros, the transverse diameter actually slightly exceeds in Deslongchamps' 5th plate that of the oran-outan. For all practical purposes of classification, however, it may be said that in youth, before the action of the biting muscles has altered the typical outward aspect of the brain-case, the oran-outan, gorilla, and chimpanzee exhibit skulls of which it cannot be predicted that each exceeds the others in the proportion of its transverse diameter.

Professor Deslongchamps says, "Pour bien saisir les rapports, souvent cachés, des êtres entr'eux, l'état adulte ne suffit pas toujours; dans cet état, ce sont surtout les différences qui se prononcent; dans les premiers âges, les ressemblances sont plus accusées, les affinités sont moins masquées. Il est utile, dans l'étude des animaux, d'imiter les botanistes, qui vont chercher les affinités des genres et des familles des végétaux dans les premiers rudiments des fruits, de la graine, de l'embryon, etc. Le groupe des singes anthropoïdes est remarquable entre tous par les changements, je dirais presque par les métamorphoses, que subissent leurs têtes."† The comparison of the skulls of the anthropoid simiæ in their young state, made by the cautious and philosophical Dean of the Faculty of Sciences at Caen, therefore, may be accepted as evidence against the hypothesis of the coincidence and derivation of the short and long-headed races of men with and from the alleged brachy- and dolichocephalic genera of Asiatic and African apes.

The foregoing table is drawn up with a view to exhibit generally the number and proportions of extinct and existing mammalia which have been found in a fossil state in deposits where the remains of man have also been discovered. With no pretensions to completeness, it may yet serve as a convenient record, and may, to a certain extent, demonstrate the greater antiquity of *e. g.* the Abbeville beds as compared with the Danish Kjökkenmöddings, evinced by the greater proportion of extinct species in the former deposit. It must however be borne in mind that the mammalia of the Somme valley may not have attained a more northern range during the post-pliocene age, whilst boreal species existing in England and Denmark at the same time might leave no remains in post-pliocene strata in Gascony or Sicily. We know too little respecting the distribution of mammalia over limited areas in the later tertiary strata to entitle us to form any comprehensive generalization.

In this table, I have made use of the researches of M. Lartet (Geol. Journal, 1860, p. 471 and 491, and Natural History Review, 1862, p. 53); Mr. Prestwich (Geol. Journal, 1860, p. 189, and

* Sur le Gorilla, par Professeur Owen, avec six planches ajoutées par Eudés Deslongchamps. 8vo. Caen. 1861.

† Loc. cit. p. 6.

Philos. Transact. 1860, p. 277); Dr. Falconer (Geol. Journal, 1860, p. 99); Dr. Schauffhausen (Nat. Hist. Review, 1861, p. 155); Mr. Busk (Nat. Hist. Review, 1861, p. 172); Mr. Lubbock (Nat. Hist. Review, 1861, p. 489, and N. H. Review, 1862, p. 26); and Mr. Dawkins (Proceedings of the Geological Society, 1862).*

In the Map which accompanies this paper, I have indicated the locality of some of the most authentic remains, the antiquity of which has been strongly advocated. It is not however intended to be conveyed that any of the remains here indicated were contemporaneous. The contemporaneity of some of them with the extinct mammalia is hitherto undemonstrated. It is certainly significant that so many instances should occur in the extreme south-west of England, to which the early Britons were driven by their Saxon conquerors, and where the traditions of British local history and the Cornubian dialect still survive. The remains from the Land's End, Plymouth, and Mewslade may have been those of early Britons, and their antiquity, unproven by any chemical or geological evidence, may not date further back than the period of the Saxon conquest.

Not the least point of interest in the table on page 228, is the fact that in Gascony and Devonshire we have evidence of the contemporaneity of the horse and the ass, both animals domesticated by man, with the extinct mammoths, rhinoceri, cave-lions, bears, and hyænas. The question then arises, whether the fossil horses and asses are specifically distinct from the existing, as, if identical, the commonly received doctrine that the horses and asses were introduced from a warmer climate must be essentially modified. It might be supposed, that the horses and asses of the post-pliocene might have been domesticated by the early pre-Gascons or pre-Devonians, and have possibly aided them to exterminate the elephants and rhinoceri. The association of human remains with those of *Machairodus* at Kent's Hole is not a more remarkable fact than his association with *Elephas antiquus* and *Hippopotamus major* in the Somme valley and in Sicily. Remains of *Hippopotamus major* have also been found in Kent's Hole.

Switzerland and the Kjökkenmöddings, belonging to a later epoch in the so-called "Stone Period," afford us first evidence of man's faithful companion, the domestic dog; and the former locality indicates also the proof of goats and sheep, specifically indistinguishable from the existing species. With these in Switzerland are associated remains of the *Bos primigenius*, the *Bos frontosus* of Nilsson, and the *Bos longifrons*. The latter species was domesticated by the early Europeans, and probably formed the *souche primitive* of our domestic oxen. Whether some *primigenius* blood may not possibly exist in our breeds, may be reasonably doubted; but the conclusions of Professor Nilsson, who derives an existing breed of oxen from the *Bos*

* The illustrations to this paper are taken from Professor Busk's paper (N. H. R. p. 172, etc.); from Squier's Monuments of the Mississippi valley; and Maury's 'Indigenous Races.' I am indebted to Mr. Mackie for the use of the Muskham and Heathery Burn relics, and for the sketches of the Eastham and Engis skulls.

frontosus, will need further discussion before their acceptance by palæontologists. With these domesticated or domesticable species of ox, flourished in Switzerland the *Bison priscus*, a species which the most strenuous efforts of the early Europeans would not have rendered capable of serving as a docile, milk-producing beast. The musk-buffalo *Bubalus (Ovibos) moschatus*, which lived in glacial clay and drift in England contemporary with the elephant, and tichorhine rhinoceros, has not hitherto been found associated with the remains of man.

Morton, in his posthumous manuscripts,* said, "Why may we not discover the remains of man in the tertiary deposits, in the cretaceous beds, or even in the oolites?"—a supposition which, considering we have not yet quite proved his existence in the post-pliocene, is as probable as that "for the real origin of man we must go immeasurably further back from the time of the existence of man amongst the Mammoths, into the great Pliocene *or Miocene* ages."

When we find his remains in the tertiary or secondary strata, it will be time enough to discuss the question. Till then, the negative evidence which disproves the existence of monkeys, the ancestors of man on the derivative hypothesis, in any stratum below the eocene rocks, must check our desire to anticipate the conclusions which future palæontologists may arrive at, through a slow and cautious process of induction and observation.

With the broad question of the antiquity of the human race the foregoing remarks have no necessary, or even contingent, connection. A higher and more satisfactory evidence than any which the geologist or the cranioscopist can bring to bear, is furnished us by the researches of those ethnologists and philologists who have most studied the affiliations and relations of the most ancient languages of the globe. Upon the supposition that such languages as the Sanscrit, Greco-Latin, Teutonic, Keltic, and Lithuanian, have been derived from a once-primeval "Arian" stock, a vast lapse of time is necessary during which their derivation and divergence from such parent stem took place. Upon the rejection of the "Arian" hypothesis,† and the acceptance of the doctrine of diverse ethnic centres of linguistic origin, an equal or greater lapse of time is necessary during which such a language as the Greek could have improved by ascensive development from the simple utterances of a barbarous early tongue to the high grade of philological civilization when Homer wrote. Such a supposition would corroborate the conclusions to which *à priori* analogy would lead the geologist; but it would leave the problem of the origin of the inferior non-"Arian" races of men unsolved. The great question of the origin of these races, whether as our representatives in a state of arrested moral and mental development; whether as the scanty remnants of inferior types which, called into being ages before the advent of the "Arian" race, have passed the fore-ordained limit which "species" can attain, and are

* Usher, in Nott and Gliddon, 'Types of Mankind,' p. 343.

† Crawfurd, 'Antiquity of Man on the Evidence of Language.' Trans. Ethnological Society, 1862.

slowly succumbing before the superior mental force of their exterminators, "the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly following"* the extirpation of the lower race; are speculations which cannot be solved by the inspection or measurement of any series of skulls, still less from so limited a number as those which I have noticed above.

Upon a review of the above facts, it appears that we may arrive at the conclusions that brachycephalic skulls did not antedate dolichocephalic skulls in time, throughout the whole world; that no analogy exists between the distribution of brachycephalic and dolichocephalic skulls of man, and the distribution of brachycephalic and dolichocephalic apes; that the proofs of the antiquity of the Neanderthal and Engis skulls are not complete, the geological and chemical evidence being defective; that the persistent interparietal bone of the Muskham skull is not a mark of the lower rank of the race to which it belonged; and that large supraorbital ridges are not *per se* proofs of simial affinity, or anthropic degradation.

The above conclusions, it may be said, are purely negative. They are so; but it must be borne in mind that we are not entitled yet to lay down general affirmative conclusions. The popular adage, "He knows most, who believes least," should be more generally accepted amongst scientific men. A future age alone may enable us to solve many of the difficulties which at present beset our path, and may dissipate the prevailing or the proposed theories as to the recent or ancient antiquity of man. Till then, the constant observer of recorded fact follows his track through the devious labyrinth of Anthropology, conscious that by a steadfast adherence to exactitude he may possibly succeed in throwing some small light on the nature of the earliest evidences of the human race.

The question of the nature and date of anthropogenesis, like that of cosmogenesis, will perchance not be solved for many generations yet to come.

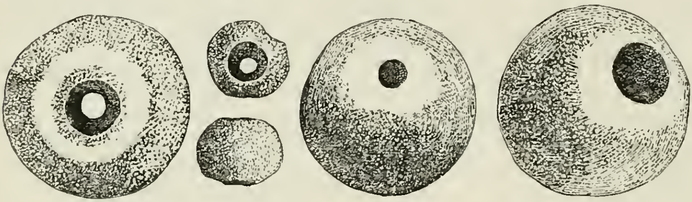
THE DISPUTED BEADS FROM THE DRIFT.

By James Wyatt, F.G.S.

It is not improbable that, in the eager search for flint implements, some of us may underrate the importance of objects which might serve to throw light upon the interesting subject of the antiquity of the human race. Anxiety not to lose any evidence bearing upon this point will, doubtless, be accepted as a sufficient excuse for re-opening the question as to the perforated balls found in the Drift, displaying proofs of the workmanship of man. We have had conflicting opinions upon these objects, but I am not aware that anything decisive has been published. It is desirable, under such circumstances, to

* Darwin, 'Origin of Species,' 1st edition, p. 489.

obtain as many facts as possible, and get the question settled. My first acquaintance with these objects occurred about fifteen years ago; for as I was uncovering some Anglo-Saxon remains in the Kempston Gravel-pit, near Bedford, I found several round stones perforated through; and so strongly was I impressed at the time that they were the personal ornaments of the ancient chieftain just exhumed, that I actually presented them to the Archæological Society as Saxon beads. Subsequent examinations of the Drift gravels, however, convinced me that the balls were of an earlier period than the Anglo-



Hollow specimens of *Coscinopora* from the Gravel Drift of Bedford.

Saxon, whether works of art or natural productions. They are described by some naturalists to be specimens of the Chalk fossil named as the *Coscinopora globularis;* but the great question for consideration is, how did they become perforated? The theory put forth by some objectors is that they were bored by an insect or worm when they were in their soft, primitive condition; but it is difficult to understand how the most voracious insect could seize upon a perfectly round object and drill through it, most accurately, a thoroughly straight tunnel of uniform bore. I have lately examined more than two hundred specimens from the low gravel without finding a single crooked or winding bore; but on making sections of some of them I have seen markings which appeared to me to indicate drilling with a tool after the object was fossilized, rather than the gnawing of an insect whilst the sponge was soft. There are certain facts in connection with these little globes to be borne in mind in the discussion of the question:—They are found in the Pleistocene Drift gravels and sands which contain the fossil bones of the extinct mammals and the flint implements; and the perforation is not a natural condition of the sponge; were that the case, the specimens would be uniform in that respect, whereas some are found entire, without the slightest hole. The gravel-beds of this county, as well as those of Abbeville and Amiens, contain them, and we know that they have been regarded as works of early art in France as well as England; and they are such perfect beads that general observers unhesitatingly (and not unreasonably) pronounce them to be portions of ancient necklaces. The learned Dr. Rigollot, who devoted great attention to the Drift, gave the opinion that "les petites boules avaient servi à former des colliers à l'usage des peuples sauvages:" but subsequently a strong objection was taken to this opinion by M. Albert Gaudry, who, in a communication published in the Transactions of the Institute of France, denies that there is any evidence for the assertion that these are works of art, and he also takes exception to the name given to them in this country. He asserts that these fossils are found in the Chalk, perforated in the same manner as those specimens found in the Drift; and adds that this is not surprising, because the central part of the sponges is generally cellular! Surely the latter assertion cannot be accepted as a satisfactory account of the *Coscinopora*.

Under the present aspect of the question, it may be considered as not unworthy of discussion in these pages, and with this view it is suggested that some account of the observations of geologists well acquainted with the condition of these fossils in their natural beds in the chalk should be solicited, as well as of those who find them in their transported position in the Drift. With this view I forward specimens from the gravel for comparison with any which may be obtained from the chalk; and it will be well if a microscopic examination of the borings in both kinds be made, so as to afford some information upon the mode in which they were drilled. I think it may be taken as a certainty that the *Coscinopora* or *Orbitolina*, in its first or living state, has no hole through it, but a small indentation, which may be observed in many of those in a fossil state. But on this point valuable information could be given by Mr. Rupert Jones, who is so well acquainted with the Foraminifera, if he will pardon my reference to him. At all events, the perfect hole through the ball is not, in my opinion, a part of the natural structure of this variety of the *Orbitolina*, and the question is therefore, was it a work of simple art of some of the earliest tribes of the human family?

CORRESPONDENCE.

The so-called Beads from the Drift.

Dear Sir,—In reply to the above inquiry respecting the small, subglobular, perforated bodies found not unfrequently in the gravel of chalk-districts, and particularly noticed to occur in Bedfordshire and at St. Acheul, I have to state that, as everybody knows, they have been derived from the Chalk, in which similar fossils are abundantly found, either in the perforated condition, or solid, or with a more or less shallow hole in their substance. They may be found by careful search in the chalk itself, on the beaches under chalk-cliffs (as at Ramsgate, etc.), and in drift beds the materials of which have been furnished by the Chalk (in the gravels above-mentioned, in more limited deposits of chalky drift, as at Copford, Essex, or in the decomposed surface of chalk and chalk-marl along the bottom slopes of the North and South Downs).

These little fossils have had several names given to them, and they have usually been regarded as sponges; but, in 1860, my friend Mr. W. K. Parker and myself were led to study them in the course of our researches on Foraminifera, on account of one curious little form after another coming under our notice from different sea-sands and fossil deposits, all of which were related to Williamson's *Patellina* on one hand, and to D'Orbigny's *Orbitolina* on the other. These varieties we described very briefly in the 'Annals of Natural History' for July, 1860 (3rd series, vol. vi.), and we traced a strong line of natural connection between some twelve more or less distinct varieties of what we termed *Orbitolina concava*, Lamarck, sp. Since then, we have again worked at this subject, with Dr. Carpenter; and, having somewhat modified our opinion as to the closeness of the presumed relationship of *Patellina* and *Orbitolina* (*Tinoporus*, Carpenter), we do not regard the Patelline as belonging to the same species as the Orbitoline forms—making two species instead of one. But we still are fully convinced that, however spongioid it may appear, the *Orbitolina globularis* is a foraminifer, and a variety of *O. concava*, Lamarck, sp. The specimens usually found in the chalk and other cretaceous beds are large individuals of this very protean species, the typical form of which is concavo-convex, or cupuliform; whilst other varieties have flat, plano-convex, or even biconvex and globular shapes. The concavity of the typical variety becomes, in many of the globular forms, a small cavity, a hole, or even a neat cylindrical perforation. The last feature may be due, perhaps, to the *Orbitolina* having grown around a smooth stem of seaweed. At all events, such perforated specimens are natural, and as abundant in the chalk as those of different conformations.

In the 'Annals of Natural History' above referred to, after describing those *Orbitolinæ* to which De Montfort's *Tinoporus baculatus* is referable, we go on to a largish sugar-loaf form from the Upper Chalk of Ciply, Belgium, and to a smaller and globular variety in the same deposit, thus:—"In the same deposit are somewhat smaller and globular specimens, in which the granular growth of the septal edges is still greater; so that continuous, rough, sinuous walls of division are produced, marking out irregular polygonal spaces, including one or more cells, the faces of which lie low down below the surface. Essentially similar septal projections constitute the limbate feature in *Rotalia Beccaria*, var. *Schrœteriana*, and *R. repanda*, var. *Carocolla*. Similar globular *Orbitolinæ* (*O. globularis*, Phillips, sp.) are common in other cretaceous deposits.

"*Millepora? globularis*, Phillips (Geol. Yorksh., pl. 1. f. 12) and Woodward (Geol. Norfolk, pl. 4. f. 10–12), *Tragos globularis*, Reuss (Böhm. Kreid., p. 78, pl. 20, f. 5), *Coscinopora globularis*, D'Orb. (Prodrom., ii. p. 284), and Morris (Catal. Brit. Foss., 2nd edit., p. 27), is our *Orbitolina globularis*. Michelin's *Ceriopora Avellana* (Icon. Zooph, p. 208. pl. 52. f. 13), from Sarthe, appears to us to be a large specimen of the same variety. Its probably adherent habit and perforated condition are not inimical to this view.

"In some of the figured specimens of *O. globularis*, the not unusual hole in the base is indicated. Occasionally individuals are perforated by a more or less irregular tubular cavity. The roundness of the specimens, and their holes and tubular cavities, appear to have suggested to the old Flint-folk of the Valley of the Somme, that they might be used for beads; for such perforated *Orbitolinæ* are frequent in the gravel that yields the flint axes" (pp. 34, 35).

I may add, that the imperforate *Orbitolinæ* occur in the gravels, just as much as the perforate. Also that the perforation of the non-drifted specimens in the chalk is often just as smooth and straight as if artificial; the interior surface is not worn, however, but consists of the natural structure of the organism.

T. RUPERT JONES.

April 22, 1862.

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

Geologists' Association.—*May 5th*, 1862.—"On Bone-beds—their occurrence in Sedimentary Deposits, and probable Origin." By George E. Roberts, Esq. The author described those zones of osseous and coprolitic matter which occur in parallel positions nearly throughout the range of sedimentary strata. Commencing with the most recently deposited bone-beds, he described in descending stratigraphical order those of the Eocene, Wealden, Oolitic, Liassic, Rhætic, Carboniferous, and Silurian ages; pointing out the peculiarities in the position of each, and its range through the British area, and its relative correspondents in Europe and elsewhere.

The author's conclusions were that these deposits presented the simple and normal life-forms of the period, unaugmented, as a rule, by any drift of dead fishes and crustacea from other localities or by any cataclysmal change or local epidemic destroying life in the seas. Bone-beds he regarded as representing more nearly than other deposits the actual population of the areas in which they occur at that period of their past history, and he urged that special search should be made for life-relics in or near to such zones; for a rock, he considered, was generally not only more fossiliferous and richer in the ordinary organisms of the period in the stratigraphical vicinity of a bone-bed, but also contained intermediate forms linking together past species with those which succeeded, a consequence of change in the water from salt to fresh, or *vice versâ*, at the time of their deposition.

The probability was that all bone-beds were deposited in shallow water, swept by light currents, under geographical conditions favouring the multiplication of fish and crustacea in Archipelagic areas, which are ever seen to be crowded with marine life, and are the great feeding grounds of fishes. Of this we have a modern example on the cod-banks of Newfoundland.

2. "On a Superficial Deposit near the Blackfriars Road." By C. Evans, Esq. In this deposit, some mammalian bones and land and fresh-water shells of recent species have been found. The deposit consists of peat and woody clays, resting on a bed of gravel, and was exposed in the excavations for the Charing Cross Railway.

Manchester Field-Naturalists' Society.—We have received the annual Report of this Society, which announces its continued prosperity both as to funds and members, and the general and deserved success of the excursions and soirées. We shall not soon forget the brilliant display of excellent diagrams and the large and instructive collections made by this Society in the Free Trade Hall on the occasion of the British Association Meeting, and we should freely spare a page or two of our much-demanded space to notice their labours if they had given us the opportunity of doing so. All the geology however they appear to have done was the picking up some Carboniferous calamite stems when the Todmorden Botanists fraternized with the Manchester Naturalists at Whiteley Dean. "So little," says the report, "of Nature's archæology can be read upon the surface near Manchester—scarcely any, indeed, except in the fossil herbariums of the coal-pits—that to find such relics in our path was peculiarly interesting." However, if the naturalists do not do much geology, the Manchester geologists do—and well too, as the papers of Binney, Hall, Dickinson, Darbishire and others testify.

DECOMPOSING BED OF BASALT

Over the Giants' Causeway, County Antrim.

[From a Sketch by G. V. Du Noyer, F.G.S.]

S. J. Mackie, F.G.S., del.

NOTES AND QUERIES.

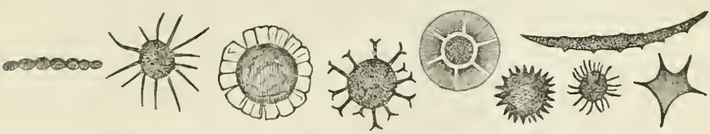
Decomposing Basalt.—At page 139 we gave a view of the "Cheese Grotto" of Bertrich, Baden in the Eifel, in illustration of the peculiar spherical condition assumed in some cases by blocks of basalt. We give, in Plate XII., another excellent illustration of the phenomena presented by decomposing basalt, from an admirable sketch taken over the "Giants' Causeway," in Antrim, by our talented friend and geologist, Mr. G. V. Du Noyer.

Human Relics.—I have just received intelligence of a human skeleton having been found in a fissure in the limestone-rocks at Kellet, in Lancashire. The skull will be transmitted to me, and, should any abnormal peculiarities present themselves, will be described in the 'Geologist.'—

May 26, 1862. Charles Carter Blake.

Mammalian Remains.—Remains of *Elephas primigenius* have been found nine feet deep in ferruginous sand, at Demblans (Jura), in the railway-works Besançon and Bourg. These relics have been placed in the Museum at Lons-le-Saulnier.

Microscopic Organisms in the Palæozoic Rocks of New York.—At Professor Dana's suggestion, Dr. M. C. White, well known for his devotion to the microscope, has examined various specimens of the hornstone nodules found in the Devonian and Silurian rocks of New York, and this research has been rewarded by the discovery of abundant organisms referable to the Desmidiæ, besides a few Diatomaceæ, numerous spicula of sponges, and also fragments of the teeth of Gasteropods. Among the Desmids, there is a large variety of forms of Xanthidia supposed to be the Sporangia of Desmids, besides an occasional duplicated Desmid; also lines of cells, some of which appear to be sparingly branched. The researches have been mostly confined to the hornstone of the Corniferous



Microscopic organisms from Palæozoic rocks of New York.

limestone; though extended also to the hornstone from the Black River limestone and that of the Sub-Carboniferous limestone of Illinois, both of which contain some organisms.

The hornstone nodules from the Black River limestone (as well as the Corniferous) have been since examined also by Mr. F. H. Bradley with similar results.

These observations will be regarded with much interest by geologists as well as by microscopists. They carry back to a very early epoch forms of life which have hitherto been looked upon as belonging only to a much more recent era in the life of our planet.

The analogy of these hornstone nodules to the flints of the chalk is obvious; and the discoveries here announced may be regarded as establishing their similarity in origin. The organisms figured so closely resemble those of the flint that they might be taken for them; it is difficult in all cases to make out a difference of species.

The extreme abundance of the hornstone nodules in the palæozoic limestones of America will render it easy to our Transatlantic contemporaries to multiply observations in this new field of research, which presents an interesting addition to the labours of the microscopist, while English geologists should at once examine the siliceous concretions which occur in our British rocks of older than cretaceous age. It will be remembered by those who undertake such examinations that the use of turpentine renders the chips of chert almost as transparent as glass.

In 'Silliman's Journal' for May, Dr. White publishes descriptions with figures of some of the more frequently recurring forms hitherto observed by him; some of which figures we copy here for the benefit of our readers, referring those who are specially interested in the subject to our first-class contemporary, the 'American Journal of Science,' for further details.

REVIEW.

Monographie des Gastéropodes et des Céphalopodes des Couches Crétacées Supérieures du Limbourg. By M. Binkhorst.

We recently noticed (page 79) an excellent Monograph by this geologist on the Gasteropoda of the Upper Chalk of Limbourg; since then we are indebted to M. Binkhorst for a copy of his valuable Monograph of the Cephalopoda of the same geological beds, illustrated by six handsome quarto plates, containing ninety-one figures. The letter-press consists entirely of descriptions, lists of synonyms, and stratigraphical ranges of the following species, which are met with in that district:—*Belemnitella mucronata,* D'Orb.; *Acanthoteuthis Maestrichtensis,* n. s.; *Nautilus depressus,* n. s.; *N. Heberti,* n. s.; *N. Vaelsensis,* n. s.; *N. Lehardii,* n. s.; *N. Danicus,* Schlot.; *Rhyncholithus Debeyi,* Müller; *R. minimus,* n. s.; *R.? Ruchii,* Müller; *Ammonites pedernalis,* Buch.; *A. colligatus,* n. s.; *A. Decheni,* n. s.; *A. exilis,* n. s.; *A. pungens,* n. s.; *A. laticlavus?,* Sharpe; *Aptychus rugosus,* Sharpe; *Hamites rotundus,* Sowerby?; *H. cylindraceus,* D'Orb.; *Scaphites constrictus,* D'Orb.; *Baculites Faujasi,* Lamarck; *B. anceps,* Lamarck; *B. carinatus,* n. s.

We are very glad to know that M. Binkhorst is busily preparing a Monograph of the bivalves of these interesting beds of Chalk, and that every day his researches are rewarded with new forms, not only of Conchifera but of Gasteropods.

Within the last few weeks he has added no less than thirty new species of the latter, to the number described in his Monograph, a list of which was given in our February number.

Rich as this Maestricht Chalk is in genera and species, we are satisfied that the "Chalk-rock" beds of our own Upper Cretaceous Series would as richly reward English collectors as we are glad to find these Maestricht beds are rewarding our indefatigable and talented Flemish contemporary.

Erratum.

In the references to the Plates in this number of the 'Geologist,' for Plate XIII. read Plate XIV., and for Plate XIV. read Plate XIII.

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"Perched Boulder," Dunmanway, Co. Cork.

[From a Sketch by G. V. Du Noyer, Esq.]

S. J. Mackie, F.G.S., del. et sc.

THE GEOLOGIST.

JULY 1862.

ON THE EVIDENCE OF GLACIAL ACTION OVER THE SOUTH OF IRELAND DURING THE DRIFT PERIOD; AND OF A SUBSEQUENT SLIGHT ELEVATION FOLLOWED BY A DEPRESSION OF THE LAND, TO ITS PRESENT LEVEL.

By George V. Du Noyer, Esq., M.R.I.A.

When "the waters were divided from the waters" and they were called "seas," the level at which they were allowed to rest, being determined, has ever since remained immutably fixed. With the land, however, it is very different; its elevation above the sea, and consequent outline,

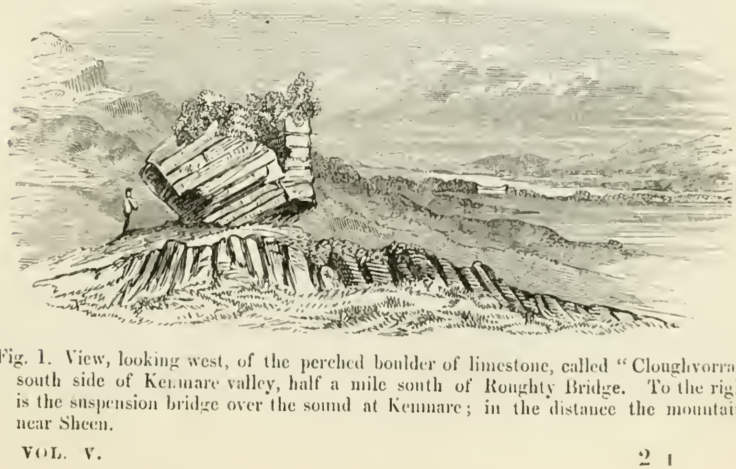

Fig. 1. View, looking west, of the perched boulder of limestone, called "Cloughvorra," south side of Kenmare valley, half a mile south of Roughty Bridge. To the right is the suspension bridge over the sound at Kenmare; in the distance the mountains near Sheen.

has varied from the very moment it "appeared" or in other words arose from beneath the "waters," and each successive geological era comprised within itself countless changes in this relative distribution of Land and Water, and many marked variations in the climatal agencies effecting the one, and in the tides and currents which sorted the shingle, sands, and finer sediments formed by the other. If proof of the truth of this be required we have but to pause before any bed of conglomerate, in any strata from the lowest to the most recent, and we have there presented to us a clear evidence of a period of local destruction in rocks previously formed and consolidated, and a consequent reproduction out of their disintegrated masses; but should we find in that conglomerate a block of a still *older* conglomerate, and this, on examination, was found to contain pebbles derived from ancient fossiliferous rocks in which we discover the remains of shells and corals, we clearly see that the process of formation, consolidation, destruction and reproduction has been going on during countless ages before the formation of the conglomerate we first examined. In vain we try to shape each link of this apparently endless chain of past cause and effect and effect and cause, till our imaginings are lost in what has aptly been termed "the past eternity."

That the earth has been subjected to marked climatal changes during past geological times is proved by its fossils. Beds of coal similar in every respect to those found in Europe and containing what we believe to be tropical plants, are found in what is now the Arctic Regions, S.E. of Melville Island, and we have evidence to show that similar changes of climate obtained long before the Carboniferous period, as Upper Silurian rocks are found at the N.W. extremity of Baffin's Bay.

In the study of geology there is this great truth, which the inquirer must never lose sight of, that the *sea* is the great superficial laboratory of the earth; the true *Lethe* in which is plunged the newly-made soul of matter, wherein it loses as it were the consciousness of its past state of being. The sea, ever destroying, ever creating, is a type of the Great First Cause, and the only permanent and unalterable constituent of matter.

The laws determining the physical changes which modify the outline and condition of the solid portion of the globe hold good up to the present hour; and though these changes are so gradual that the short space of human record is capable of pointing out only their most trivial results, yet in the lapse of cycles of ages, alterations will be wrought by the sea at the surface, and by the earthquake power beneath the crust of the globe, far beyond the most visionary flights of imagination ever indulged in by the most accomplished philosopher of nature.

The last great geological event of which we can detect the traces over the British Islands, was their gradual upheaval from beneath the sea; before that period, which comparatively speaking is a very recent one, we know not how often our islands and Western Europe had been submerged and elevated, or what were the outlines of the land at these different post-Tertiary periods; neither can we fix the particular time when the Chalk of the South of England and the North-west of France was cut through to form the Straits of Dover, or the Basalt of the county of Antrim and the west coast of Scotland divided by the Irish Channel. We have however every reason to believe that what are now the British Islands formed a portion of the European Continent before the creation and distribution of the existing Flora; and doubtless during the lifetime of the elephant, rhinoceros, hippopotamus, hyena, bear, etc., whose bones are found in our caves as well as in those of the Continent. While from recent discoveries it is possible that Man even may have been co-existent with these now extinct animals.

The traces left by the sea during the period of the last upheaval of the land, are generally understood by the term "Drift," and they are such as to lead to the belief that ice floating over the sea and glaciers forming in the mountain gorges were the chief agencies of destruction, while the former, aided by tides and currents, caused the transportation of rock masses over wide-spread areas.

The presence of icebergs being once admitted, we must infer that the temperature of the sea was much lower in these latitudes then than now, and at the cessation of this period of upheaval the climatal conditions must have closely approached to those of the Arctic zone; our mountain glens were occupied by glaciers for a very long period indeed, as is proved by the extensive moraines now to be seen at their mouths, and the grooving and polishing of the rocks along their sides.

The last great current of the glacial sea certainly flowed from N. and N.W. to S. and S.E.; this is chiefly demonstrated by the occurrence of large boulders of peculiar rocks scattered on the surface to the southwards of where they are recognized *in situ*.

By studying the contour of the loftiest mountains in the South of Ireland, such as Carrantuohill—the highest, 3414 feet above the sea; the Reeks of Macgillicuddy, 3000 feet; some of the mountains to the west of the Reeks, such as Caher, 3200 feet; with Brandon Mount, 3121 feet; and Benoskee Mount, 2713 feet—both in the Dingle Promontory; we must be struck with the singular fact, that up to an elevation of 2400 feet they are all rounded and covered with water-worn blocks, while above that level they are more or less peaked, and their surfaces rugged and bristling with the coarsest angular débris and massive rock-flakes, evidently the result of long-continued atmospheric action; to this there is one exception in Mangerton Mount, which is 2715 feet in elevation, whose summit is completely rounded,—a fact which we may account for by supposing it to be the result of some local depression of this part of the mountain chain during the period of the "Drift" action, or a subsequent upheaval after its cessation.

From this peculiarity in the outline of the mountains we may suppose that before the last great upheaval, and at the commencement of our last or glacial "Drift" period, the land over the South of Ireland lay submerged to the depth of about 2400 feet,—thus forming a group of islands, the highest of which was the Peak of Carrantuohill,—having shoal-water extending from them in the direction of N.E. and S.W., the present longest axis of the mountain chains, and deep channels between them, which are now our valleys. Over this sea great masses of ice floated, and carried blocks of rock to the S. and S.E. from what is now the Galway mountains, and possibly other mountain chains, which lay in what is now the Atlantic, and scattered them over the islands. As the land arose gradually from the waters, its shores and shoals frequently arrested the travelling iceberg; these, on grounding and melting, deposited the blocks attached to them; or, on being again floated off by tides, currents, and storms, carried with them any rocks which might have become attached to them or have fallen on them from any cliff at the base of which they had been temporarily arrested in their course to the southwards.

At an elevation of over 2200 feet above the sea, in a remarkable hollow at the northern summit of Mangerton Mount, there now lies the lake called "The Devil's Punch-Bowl;" along its northern side its waters are dammed up by a mound of very coarse subangular detritus of local grits and sandstones, having a height of 2319 feet above the sea, or 119 feet above the level of the lake. On the summit of this well-marked mound there are many large angular perched boulders poised one over the other, and these could only have been placed in their present position by having been slowly dropped from an iceberg as it melted from the heat of summer. Had such a piling of angular blocks occurred under water and within reach of any floating mass of ice, it would have been thrown down by the first concussion.

As the land still slowly emerged from the sea, the disintegrated materials from its shores became more or less sorted by the action of the tides and currents, and arranged in certain localities most favourable for their reception. Thus, the low ground which extends from Killarney to Millstreet, lying at the northern base of the mountains commencing at Carrantuohill and Skreaghmore on the west, and including the Reeks, Mangerton, Stoompa, Crohane, the Paps, and ending in the range of the Caherbarnagh mountains on the east, is covered by a thick accumulation of well-rounded, coarse Boulder-Drift, all derived from the rocks of the neighbouring mountain chains; being, in fact, the sweepings of the sea from out their various valleys and gorges. Although this Drift is spread out on the Carboniferous limestone which extends along the flanks of the mountains, it is quite free from any fragments of that rock—a fact which aids in determining the origin of the deposit. The highest elevation to which this Drift reaches up the flanks of the mountains at Mangerton is about 600 feet; and in the neighbourhood of Killarney, along the road to Muckross, this deposit is escarped to the depth of 300 feet.

One of the most clear and unmistakable examples of an erratic ice-borne block, or perched boulder, is to be seen near Kenmare, in the county of Kerry, on the hillside about half a mile to the south of Roughty Bridge (Fig. 1, p. 241). It consists of a large and nearly rectangular block of grey, thin-bedded, cherty limestone, formed of a series of beds which have come away from the main mass along two sets of joint planes, which cut each other nearly at right angles. This boulder is known by the name "Cloughvorra;" it measures 26 feet from north to south, 16 feet from east to west, and is now about 15 feet to its highest point above the ground. This remarkable block rests directly on purple grits and slates of the Old Red Sandstone, the beds of which dip to the N.N.W. at 60°. The elevation of "Cloughvorra" above the sea is 260 feet, while no limestone in the valley of the Roughty river reaches a greater elevation than 200 feet, and the average height of the limestone in the valley along the northern base of the hills, on which this boulder rests, is not more than 100 feet.*

Over the whole of the Killarney district, the range of the Reeks, Torck mountain, the mountains between Killarney Lakes and Kenmare, and between Kenmare and Glengariff, wherever rock surfaces are exposed freshly or denuded of the Drift, they are more or less rounded and polished, and bear the marks of glacial striæ. This is very apparent over the rocky bosses in the Upper Lake district of Killarney, at an elevation of about 96 feet above the sea; and the striæ are observed up the western side of Torck mountain to a height of over 600 feet, where they appear to have been produced by the impinging of ice-masses against this flank of the mountain on their passage from the glen of the upper lake to the west, and before they were deflected to the northwards through the gorge between Torck mountain and the "Eagle's Nest" mountain, into what was comparatively the open sea lying to the northward.

Many rounded and striated rock-surfaces are to be seen at a height of 1000 feet above the sea in this district, the striæ having a general direction of N.W. and S.E., being frequently thin at the end pointing to the former, and blunt at that turned to the latter point of the compass. If we suppose that the force which produced these scratches was exerted from the N.W. to the S.E., and its motion to have been one of sudden starts or bumps, we should expect that marks having the peculiar form of those observed would be the result.

In such glens and gorges as the Gap of Dunloe, and what is now the bed of the Upper Lake at Killarney, the glacial striæ are invariably parallel to the longest axis of the valley, as we would expect if they had been produced by the passage of large masses of ice, or, as in the Gap of Dunloe, by the movements of a glacier. In the former therefore the direction of the striæ is N. and S., and in the valley of the latter E. and W.

At the lower or northern end of the Gap of Dunloe there is a very remarkable deposit of Drift; it consists of three lunet-shaped mounds, formed of local sand, gravel, and boulders, extending across the mouth of the glen. The two outer mounds measure fully one mile in length from east to west, by about 100 yards in width; and they are all cut through near their centre by the River Loe. As this mass of Drift extends for the distance of fully one mile from the absolute base of the mountains, and the entrance to the Gap, we may

* See 'Memoirs of the Geological Survey of Ireland,' p. 184.

suppose that its origin is twofold: first, attributable to the sea-current, and then that of the river which flowed out of this glen, and of which it is the delta; and secondly, of the glacier, which eventually blocked up this mountain gorge, when the land had been sufficiently elevated and the climate favourable for the formation of such phenomena.

The innermost semicircular mound is, therefore, most probably *the true moraine* of the glacier; it measures 700 yards in length by about 150 yards in width; its height above the sea in its central part where it is bisected by the River Loe being 224 feet, and where it is escarped by the stream to the depth of 85 feet, without the rock being exposed.

As the climate became less and less favourable for its formation, the glacier lessened in width and receded, and the rubbish brought down by it also decreased in amount, and it appears that the glacier ceased to be formed when its termination rested at a height of 800 feet above the sea, as its débris is found at that height on the northern flank of Tomies Rock.

Throughout the entire extent of the Gap of Dunloe many of the rock-bosses along the precipitous flanks of Purple Mountain, and at the end of the Reeks on the western side of the gorge are rounded and striated, the striæ being all parallel to the length of the Gap, or about N. and S.

Over many rock-surfaces along the shores at the head of Glengariff Bay, the glacial striæ are well developed within a few yards of the sea-level. This is important, as it proves that the temperature of the sea and climate was Arctic after the country had assumed its present physical features.

On the northern flanks of the Tralee range of mountains, which terminate in the summit of Caherconree, and at the mouths of the Glens of Bartugaum and Derrymore there are exceedingly well-marked small moraines, cut through by the streams which issue from these glens, and which escarp them to the depth of from 30 to 50 feet.

Glacial striæ are observed in both these gorges, and in many places the Old Red Sandstone rocks are polished, rounded, and furrowed in the direction of the length of the glens, or N. and S.

The moraines are merely single semicircular mounds, measuring nearly half a mile from end to end, where they rest on the flank of the mountain, and having a width of fully a quarter of a mile.

Over the rocky promontory in the county of Cork, formed by Dunmanus Bay on the north and Roaring-water Bay on the south, terminating in Mizen Head, the glacial striæ are very generally to be observed, their usual direction being W.N.W. and E.S.E. Some of the finest examples of glacial furrowing and polishing in the whole South of Ireland appear on the east shoulder of Mount Gabriel, at an elevation of close on 1000 feet above the sea in the gap where the road to Skull from Bautry passes; the groovings, which are some of them more than 18 inches in depth, mark the precipitous face of the hill with polished, architectural-looking flutings and mouldings. It is very probable that glacial scratches occur on the very summit of the mountain, which is 1339 feet above the sea.

Bosses of rock, beautifully rounded and polished by glacial action are exposed over all the district around Ballydehob and Skull; and at the mouths of the rocky glens there the remains of the moraines are distinctly to be seen.

On the northern flank of the Comeragh mountains, in the county Waterford, and to the E. of the village of Ballymacarbury, there

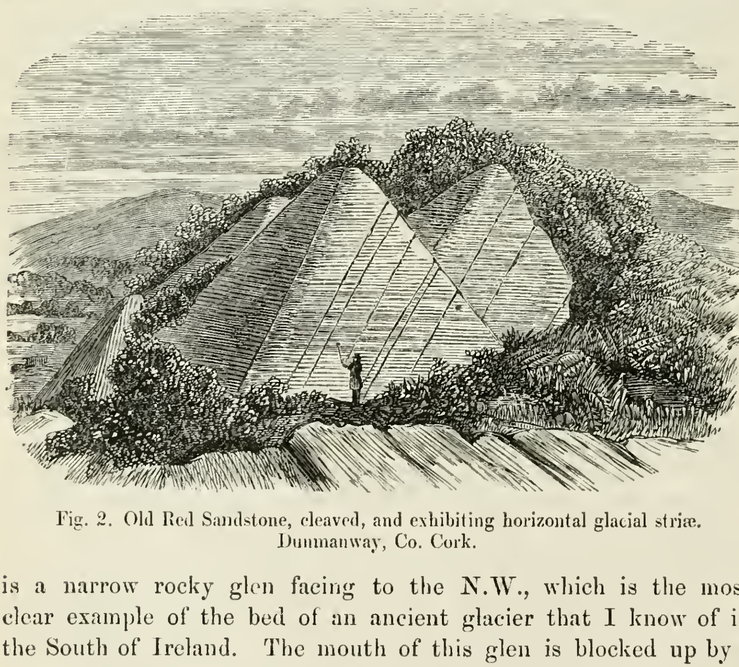

Fig. 2. Old Red Sandstone, cleaved, and exhibiting horizontal glacial striæ. Dunmanway, Co. Cork.

is a narrow rocky glen facing to the N.W., which is the most clear example of the bed of an ancient glacier that I know of in the South of Ireland. The mouth of this glen is blocked up by a series of the most perfect moraines, now cut through by the small stream issuing from the gorge.

The extreme measurement of the moraines would be about half a mile from east to west, with a width in their central part of about a quarter of a mile. In many places the rocks in this glen are beautifully polished, rounded, furrowed, and striated.

To the spectator standing on the mountain-side to the S.E. of this glen, and looking down on it, the view is most striking, and the imagination need not be very vivid to complete the picture by the addition of the glacier with the snow-covered mountains beyond.

Over the wide mountainous promontory formed by the Bay of Kenmare on the north, and Bantry Bay on the south, all the rock surfaces where freshly exposed from beneath either bog or Drift, are more more or less rounded and striated; in some glens these striæ are observed at the height of 1100 feet above the sea, the direction varying from N. and S. to N.W. and S.E., and sometimes from N.N.E. to S.S.W.

The mountains to the north and west of Dunmanway in the county Cork afford some very striking evidences of glacial action. Most of the rock surfaces being observed to be polished and scratched in the direction of N.N.W. and S.S.E., the striæ being thin at the former and blunt to the latter point of the compass. The highest elevation at which I have observed these glacial marks in this district is 975 feet, and the lowest 200 feet above the sea, thus proving that during the whole period required to elevate the ground 775 feet, or the difference between 975 and 200 feet, the conditions of the sea and climate were permanent and favourable to the formation and drifting of ice masses.

Over the summit of Coolsnaghtig Hill, which is close to Dunmanway and 975 feet above the sea, and at its eastern end, called Mount Gunnery, 757 feet high, the glacial striæ are remarkably well developed, and many perched boulders are scattered over both mountains; one large block, called "Maragh," is close to the very summit of the latter hill. All the blunt edges of the sandstone rocks over both these mountains when presented to the N.N.W. are rounded and striated, the vertical faces of the beds being marked with horizontal striæ. Over the whole of the Dunmanway district there are very many perched boulders, and some of them of enormous size; one, called "White Horse Rock," is close to the village, and there are several others near to it. The largest erratic block occurs at the distance of three miles to the westward of Dunmanway, in a hollow on the western flank of the mountains over Ship Lough; it is called "Ship Rock"

(Pl. XIII.), and there is a superstition that on All-Hallow Eve this mass floats off into the lake, returning to its present resting-place ere cockcrow. This remarkable block consists of a seriesof purple grits, and thin purple earthy layers, and now measured roughly is $40 \times 25 \times 16$ feet, representing a bulk of about 16,000 cubic feet, and weighing about 1100 to 1200 tons. Originally this mass was much larger, as large flakes have fallen off its sides from the result of atmospheric action.

On the Carboniferous slate district to the S.W. of Dunmanway, at the summit, marked 964 feet to the west of Millane Hill, there is a perched boulder of hard light grey gritty slate, measuring $6 \times 4\frac{1}{2} \times 2\frac{1}{2}$ feet, which is known to the peasantry by the name of "Gallaun Keogh." To the north of Dunmanway in the Townland of Gurtanure, and at the junction of the Caha with the Bandon River, a rocky boss affords some very interesting examples of "roches moutonnées" and glacial striæ. Here we find purple grits weathering into small pinnacles on the lines of the dip, the cleavage and the cross joints, the sides and angles of which are rounded and polished and marked with well-defined horizontal striæ. On the level polished surfaces of rock, we find the same peculiarity of form in the scratches as before noticed. They are fine at the end pointing to the N.N.W., and blunt at that pointing to the S.S.E., thus clearly indicating the direction from which the current came which floated the ice-masses forming them. The horizontal markings have not however this peculiarity, but are a series of fine groovings and sharp scratches.

Over the Carboniferous slate to the south of Dunmanway the compass bearing of the glacial striæ is generally the same as that over the Old Red Sandstone, and the mountainous district to the north. This is very well seen in the horizontal and smooth rock surfaces to the north of Ballinacarriga Lough, at an elevation of 339 feet, where the striæ run N. 20 W. and S. 20 E., the thin end of the scratches being presented to the former point.

The accompanying illustration of a perched boulder from near Dunmanway (Pl. XIV.) is interesting in many respects; it shows how readily the sandstone yielded on the planes of the slaty cleavage to what must have been the sudden concussion of an iceberg grounding on such a submerged inequality in the sea bottom as this rocky boss must have been. The view is taken looking somewhat to the westward. The general form of the rock when it was submerged in the glacial sea must have been very nearly the same as now, one side

"SHIP ROCK" and Lake with [illegible] Mountain in the distance
[illegible], Co. Cork.

From a Sketch by G. V. Du Noyer, Esq.

S. J. Mackie, F.G.S. del. et sc.

sloping to the northwards, having the southern face of the boss precipitous. The current sent the iceberg up the inclined plane facing to the northwards, till the shoaling of the water arrested its further progress. The sudden concussion thus given to the rock detached from off its precipitous brow facing to the southwards large flakes of rock, and threw them one on top of the other down the inclined talus at the base, just as a lot of books would lie if suddenly thrown down on their sides from a previously close and vertical position. It is highly probable that the iceberg here permanently grounded and melted away, leaving the perched boulder which we now see on the summit of the rock as the most palpable evidence of its short-lived existence.*

Erratic boulders of a syenitic granite, a rock peculiar to the county Galway, lie scattered over the country to the S. and S.E. of it, comprised in the counties of Clare, Limerick, and Tipperary, and some of them are to be seen as far south as the deer-park of Mallow Castle, county Cork. Hence we have a clue to the direction of at least the last iceberg current.

Many Drift boulders may be considered as local, and are due to the action of shore ice, which dropped them before they had been transported far from their parent site. Of this fact we have an example in a large block of a very peculiar kind of light grey cherty limestone, with thin earthy shale layers through it, which rests in a field close to the Workhouse of Mallow. It now lies on the coal measures to the south of the outcrop of the limestone, and similar limestone is observed *in situ* is in the deer-park of Mallow Castle, about two miles distant from the boulder, and near the base of the Old Red Sandstone hills.

The Musheramore range of mountains, lying between Macroom and Millstreet, have Drift gravelly clay resting on their southern sides to the height of 2050 feet above the sea, as is apparent on the southern slope of Mullaghanish Mountain. The southern slopes of Lackabaun Mountain, up to an elevation of 1500 feet, are dotted over with numerous large angular boulders of purple slates and grits. On the southern slope of Lackabooma Mountain, at a height of 1270 feet above the sea, numerous large angular blocks of hard greenish grit are scattered about. And thick accumulations of gravel and boulders occur, at elevations of 1000 feet, in the various glens and river valleys along the southern slope of the mountains to the N.E. of Macroom.

* See 'Memoirs of the Geological Survey of Ireland,' explanation to sheet 193.

It is somewhat remarkable, that over this district many rocky eminences and ridges, which do not attain to an elevation of much more than 1060 feet, are quite free from the Drift, which in some localities reaches a height of 2000 feet and over it. Such, for example, is the case at the Hill of Carrignaspirroge, to the west of Macroom, and to the north of the head of the Bardinch River. Without doubt this deposit once covered all the hills of this range, up to their very highest summits; but some local currents must have subsequently removed it while the district was being slowly raised above the level of the sea.

In the northern portion of the county of Tipperary there are some fine examples of glacial action and perched boulders.

Mr. Wynne, of the Geological Survey of Ireland, in his explanation to sheet 135 of the Geological Map, affords us some very valuable information on this point.

He remarks that Limestone Drift was recognized at considerable elevations on the northern slopes of the hills about Killanafinch. Large blocks of granite occur south of Toomeyvara, which have been transported from the county Galway.

Along the high ground which rises south of Moneygall large boulders of limestone are scattered over the hills, especially about Busherstown, where they attain to a height of 500 feet above the sea. On the top of Loyer Hill, south of Moneygall, at a height of about 890 feet above the sea, a large block of limestone occupies a very conspicuous position; it measures 12 feet × 9 × 7½, and it rests on Lower Silurian rocks.

On the summit of the well-known mountain called the Devil's Bit, near Templemore, and at a height of 1583 feet above the sea, Mr. Wynne discovered glacial striæ and erratic blocks of Silurian grit on the surface of the Old Red Sandstone; the direction of the striæ is from N.N.W. to S.S.E.

The occurrence of glacial striæ at this great elevation affords further evidence of the enormous lapse of time during which the South of Ireland lay submerged beneath the glacial sea during the last Pleistocene period; such scratches and groovings on rock surfaces were produced beneath comparatively shallow water, and the total amount of elevation of the land during this glacial period is thus defined with tolerable certainty.

The facts just detailed may be regarded as the most important and obvious of those relating to the evidence of glacial action over the South of Ireland.

The last fact in the history of the recent elevations and depressions of the land, is the occurrence of submarine bog along the south and south-east coast of Ireland. From the position in which this bog is found, it is evident that the coast-line as it now appears had been *first* formed, and that an elevation, sudden or gradual, took place, sufficiently great to lay dry the shores now under the sea for a distance seaward from the cliffs, sufficient to allow of the formation of marshes and lagoons, which after the lapse of ages became covered by a dense forest; but how far this forest tract extended from the ancient coast-line it is impossible to say; eventually, this forest decayed and bog was formed. The land then subsided, till, strange to say, it regained the exact level at which it stood before the existence of the bog, and the sea once more beat against its former cliffs and soon covered up the peat at their bases with sand and silt as we now find it.

The most southern locality where this submerged peat is observed is at Tralong Bay, a little rocky indentation on the coast, two miles to the south-west of Rosscarbery Creek; the bog lies close against the cliff, and is well exposed at low water. In Ross Creek, to the east of Rosscarbery, the bog at low water is denuded by the country people of the slob which covers it, and is cut and dried for fuel. Beech and hazel nuts, with small branches of these trees, are frequently found in the peat. To the east of this, at the head of Clonakilly Bay and Dunworly Creek, a similar deposit of bog is observed at low water. The same fact is noticed at the head of Courtmarshery Bay. From this place, following the coast to the N.E., we pass the entrance to Cork Harbour, and when we reach Ballycotten Bay, a distance of thirty-five miles, the submerged bog is again apparent close to the shore At the head of Youghal Harbour it is again seen. It also occurs to the north of Ardmore Head, and has lately been described by the Rev. Professor Haughton, F.T.C.D., as present in Dungarvan Bay. Still following the coast, we find it at the head of Tramore Bay; and it appears up the mouth of Waterford estuary as far as Duncannon, a distance of eight or nine miles from the main coast-line.

The occurrence of this submarine bog in a well defined estuary so far inland is very interesting, as it proves that the creek was first formed, and therefore we may argue that the general coast-line had its present outlines before the growth of the timber required to make this bog. In Bannow Bay there is a similar formation, and it again is seen in Wexford Harbour.

The coast-line now strikes nearly north and south, and is no longer indented by deep bays with jutting headlands, yet still we find that the submerged peat is present. I have heard it asserted that the anchor brings up peat off the coast to the north of Cahore Point, in the county Wexford, and I know this to be the fact to the south of Dalkey Island, and between that place and Bray.

The distance along the coast from Tralong Bay and Rosscarbery on the south to Dalkey on the north-east, over which the submerged peat has been observed, is fully 195 miles; and I have little doubt that along the south-west coast, to the west of Rosscarbery, comprising Roaringwater Bay, Dunmann's Bay, Bantry Bay, Kenmare Bay, Dingle Bay, and Tralee Bay, all these deep indentations were during the formation of this peat, either entirely or partially dry land, and covered with a luxuriant forest, which likewise formed a deposit layer of peat similar to that just noticed; and if we do not find traces of it at these places, the fact is due to the destructive action of the Atlantic on such an exposed coast, and the consequent removal of the peaty matter.

Until we have some information as to the distance from the coast-line and the extreme depth beneath the sea at which this bog terminates, we cannot speculate on the probable amount of elevation and depression to which the south and south-east of Ireland was subjected during the growth and deposition of this remarkable formation. It need not however have been very great; two or three hundred feet of elevation would now, even, cause a wonderful variation in the coast-line, and leave bare a wide belt of level land around it; and if the climate was more genial than at present, and other circumstances were favourable, we must suppose that it would be covered with forest after the lapse of ages. All that would be required is *Time*, and, from all that we can understand, Nature is most lavish of this necessary aid to the production of even her latest geological works.

ON THE ORIGIN OF SPECIES.

By Professor William King,

(*Queen's College, Galway,*) *Queen's University in Ireland.*

It would be an insult to reason to deny the power of the Omnipotent to create at once plants and animals out of inorganic or any kind of matter: on the other hand, it would be equally irrational to doubt His power to ordain and sustain laws, through the instrumentality of which *originally created* organisms could be modified and adapted to external changes. The two modes may be designated,—the first, *Autotheogeny*,—and the second, *Genetheonomy*.

I hold that an organism, whether it typifies a species, a genus, a family, an order, or a class, is an autotheogen, if it possesses a set of characters which isolate it from other equivalent groups; also, that such an organism, through being acted on by inherent and external forces, may become more or less modified, thereby resulting in genetheonomous forms. I see no reason why Mr. Darwin should not admit the same, notwithstanding that his present belief merely recognizes among animals "at most only four or five" autotheogenous roots of apparently as many classes. On psychological grounds alone, Man must be regarded as isolated from all other organisms; hence I consider him to be an autotheogenous species.

Until within the last year or two, Genetheonomy was far from sufficiently supported by the arguments of its advocates; those advanced by Lamarck, Geoffroy St. Hilaire, and the author of the 'Vestiges,' being only of partial application, or simply illustrated by a restricted group of analogies. If organisms underwent changes *only during their embryonic stage*, the author of the 'Vestiges' would have some grounds for his theory of development "by generation"—by "a universal gestation of nature, analogous to that of the individual being;" but, considering that all organisms undergo, *after their birth, and throughout the entire period of their existence*, successive modifications (less marked, it is true, in the higher Vertebrata than in the Invertebrata and Batrachia), it is manifest that the doctrine of the 'Vestiges' has nothing in its favour except a restricted group of analogical phenomena. Its author has made out a case of "parity of plan between embryonic development and the succession of life on our planet;" but he has failed, as far as I can understand the theory, in establishing "a real identity of character in the two sets of phenomena." Of late, however, Darwin and Wallace have considerably enlarged the field of well-sustained argument supportive of creation by Divine law.

But does the hypothesis of the last-named naturalists sufficiently explain the various genetheonomous phenomena? My own reasoning compels me to answer in the negative. I admit to a great extent the power of "natural selection" in producing a species; but I cannot divest myself of the impression that it only holds the rank of a subordinate or ancillary agent. The particular view under consideration, if I am not much mistaken, implies that plants and animals are modifiable by mere external influences—of course, acting by law. Entertaining this opinion, I am led to regard "natural selection," as widely removed from primary laws; and functionally no higher than chance or accident, as conceived by the untutored.

I feel a difficulty in understanding how "natural selection" could produce a species, unless other and higher principles were involved.

Every individual plant and animal is confessedly acted on by forces, the precise nature of which has never yet been revealed by science. Some conception may be formed of one, paramount in my mind, by designating it *progressive change.* A principle of this kind appears to me to be inherent in animated nature; or, how can we otherwise explain the "unity of plan" pervading both organic kingdoms,—the "phenomena of parthenogenesis,"—the "advance and progress in the main" which our life system has undergone in past geological ages?

There is no difficulty in referring instances which cannot be reconciled with "an advance and a progress in the main;" but these are obviously exceptional. I cannot agree with Mr. Darwin in his view of the "geological record"—of its being so "imperfect" as he seems to think. Many important connecting links, binding in close union all the members of our life-system, are undoubtedly wanting; but, in taking a general survey of the facts revealed by marine palæontology, commencing with the earliest organic period, and closing with the present one, it is to me a matter of surprise, considering how limited is the field of observation, that the "geological record" is so perfect. There is apparently some difficulty in accounting for the occurrence of so many invertebrate orders—low as well as high—in Cambrian rocks; but we must not overlook the fact that such groups *now* include forms of the simplest type, *doubtful even as to their ordinal rank;* nor must we overlook the probability of the primordial crustacea, annelids, cephalopods, palliobranchs, corals, etc., being more closely related to each other than is the case with their representatives of later geological periods.

The supremacy of *progressive change* may be exemplified by referring to the successive modifications which the human organism passes through in its progress towards maturity; while the ancillary or subordinate character of "natural selection" is well illustrated by the changes which external agencies have effected on the same organism, producing, as admitted by nearly all, the leading varieties of the human species.

With respect to the varieties of man, I hold that most of them are genetheonomous degradations of the Indo-Caucasian type, developed by the physical conditions peculiar to the regions they respectively inhabit. Cogent reasons may be advanced for regarding the American Indian as having descended from the Mongolian, and the latter from the Indo-Caucasian. Even the aboriginals of Australia may be looked upon as another degraded race: those inhabiting the south and west coasts are confessedly inferior to the adjacent oceanic tribes, as they appear to be incapable of constructing canoes. From some remarks recently made by Professor Jukes, one might be led to attribute this mark of inferiority to the apparent absence in Australia of indigenous timber suitable for canoes (*vide* 'Athenæum,' No. 1793). I believe, however, a more general cause has operated,—one involving physical conditions. Nevertheless, I certainly prefer accepting the particular circumstance stated, as one of the means which have brought about the degradation of the Australian, to adopting the view which considers him to be an *advanced* genetheonom of some extinct ape, even should the remains of species be found hereafter more human-like and more manipulative than the gorilla or chimpanzee.

I am disposed to regard, then, *progressive change* as one of the great primary modifying principles of organic nature; and "natural selection" as a secondary one,—the latter subordinately operating in the production of *proximately allied* specific and varietal forms.

Some years ago I contributed a few facts, which showed that variations of physical conditions, as depth of water and nature of sea-bottom, induced in certain British shells modifications of form equal to differences prevailing between many species of mollusca;* in a paper published a year or two previously, I particularly noticed the remarkable, and, in many cases, imperceptible gradations of generic characters running through the tetrabranchiate Cephalopods;† and in my "Monograph," I have pointed out the various forms assumed by *Camarophoria Schlotheimi*, and some other Permian fossils. These may be taken as evidences that I have not been inattentive to the vexed question of species. Of course, it would ill become any one to dogmatize on such a subject, and disbelieve in the future turning-up of facts subversive of his preconceived notions; nevertheless, I feel myself bound to declare, that all my observations and reasoning incline me to believe in the two modes of creation as herein advanced.

CORRESPONDENCE.

Professor King's Stratigraphical Tables.

SIR,—The Table of British Rocks, by Professor King, given in the last number of the 'Geologist' (pp. 193–7), I cannot let pass without saying, that however perfect it may be as regards those Irish rocks amongst which the Professor teaches, it is not as useful as might be to a student in the South-east of England.

Its many imperfections will be seen on comparing it with the table given in Lyell's 'Elements,' with those of a more detailed kind scattered through the lately-published edition of Jukes's 'Manual,' or with the Index of Colours of the Geological Survey. The following are amongst the most striking mistakes (in the Lower Tertiary and the Secondary rocks):—

1. The *Upper* and *Lower Bagshot Beds* are not noticed, only the Middle Bagshot (Barton and Bracklesham) being given. The *Woolwich and Reading Beds* are also left out, although the Thanet Sand (of less importance) is given.

2. The *Lower Greensand*, save its lowest bed (the somewhat local Atherfield Clay), has escaped notice.

3. The *Kimmeridge Clay*, the *Coral Rag* (with its associated beds

* See Annals and Magazine of Natural History, vols. xviii. and xix.

† See *ibid.*, vol. xiv.

of *Calcareous Grit*), the *Cornbrash* and *Forest Marble*, and the *Fullers' Earth*, and *Inferior Oolite* are all left out.

I could point out many other mistakes ; but I think that the above are enough to show that Professor King's Table needs to be a little more "revised and corrected" before it can be said to be "up to the present time." I would however remark that the good notion of giving separate columns for marine and freshwater types is in great measure marred by the formations in one column being printed on the same line with those in the other, as if they were exactly of the same age ; whereas such is not always the case. Thus, the Eocene Series (in which, by the way, the main divisions of *Upper*, *Middle*, and *Lower* are not given) should stand as follows,—classing the Hempstead Beds with it, and not with the Miocene :—

	Marine Types.	Fresh- and Brackish-water Types.
Upper Eocene .	{ Parts of the Fluvio-marine series of the Isle of Wight . . . . }	Hempstead Beds Bembridge Beds Osborne Beds Headon Beds } Fluvio-marine series of the Isle of Wight.
Middle Eocene	Upper Bagshot Sand Middle Bagshot { Barton Clay Bracklesham Beds Lower Bagshot Sand } Bagshot Beds.	
Lower Eocene .	London Clay. Woolwich and Reading Beds (part of) . Thanet Sand.	{ Shell-beds of Woolwich, etc., Pebble-beds of Bromley, etc.

In this form the table shows, at a glance, that there are no purely marine formations of Upper Eocene age in Britain ; but that there are beds of that age that are mainly of freshwater origin, etc.

I am, yours truly,

W. W.

The Trinidad Pitch Lakes.

Sir,—I observe in a paper "On the Torbane Mineral Field," by Mr. Taylor, in the February number of the 'Geologist,' a statement to the effect that the Pitch Lake of Trinidad stands in close proximity to a volcano. As this statement has been repeated in various works, and has apparently led to some false generalizations, it may perhaps be well to make the true state of the case a little better known.

No volcanic substances or erupted rocks have been found to exist near the Pitch Lake ; and not only is there no volcano in Trinidad, but, so far as I am aware, no traces have been discovered either of ancient or of recent volcanos in the island. What may perhaps have given rise to the statement above alluded to, is the existence of several so-called *mud volcanos*, or salses, which eject only mud and water, and do not possess a temperature above that of the air, and certainly do not appear to have any connection with what is usually understood by volcanic action. The neighbouring parts of South America are equally free from evidences of volcanic disturbance.

What I have stated may suffice to call attention to the subject ; and for details, including an excellent and lucid account of the bituminous deposits in Trinidad and their probable origin, I would beg to refer those desirous of knowing more on the subject to the "Report on the Geology of Trinidad," being Part I. of the West Indian Survey. The salses above-mentioned are also described in this most useful work.

Believe me, Sir,

Your most obedient servant,

B. Lechmere Guppy.

Port of Spain, Trinidad, April 2, 1862.

Archæology and Geology.

Dear Sir,—Three articles in the 'Geologist' of June, 1862, have so far interested me as to induce a few remarks, if I do not obtrude upon your space, viz. that of J. Wyatt, Esq., F.G.S., that of T. R. Jones, Esq., F.G.S., and that of your foreign correspondent, S. J. M. The two former discuss the orbitolina; the latter writes on the trenching of geologists in their investigations on the domains of the archæologist and the historian. The illustrations given by J. Wyatt, Esq., F.G.S., coincide exactly with specimens in my collection which I have obtained from the Chalk in different localities of this Island. My specimens include varieties which range in a graduated scale from the orbitolina, with a small indentation, to those with a perfect and natural hole, smoothly perforating these foraminifera, without the intervention of artificial boring. In addition to these geological specimens, I possess also antiquarian specimens of the orbitolina, obtained from tumuli or barrows examined by me—indeed, one at least, was obtained from among the beads of a necklace found upon an Anglo-Saxon skeleton, which convinced me that it had been strung as a bead among those of amber, glass, and terra-cotta, which ornamented the person of our exhumed ancestor. There can be little doubt that these ancient people appropriated both natural as well as artificial perforated objects for their personal adornment. From the same barrow from which I obtained my perforated orbitolina, I procured a naturally-perforated pebble, and an artificially-perforated lump of lead, while the amber beads consisted of natural lumps of unshaped amber, simply perforated for suspension. S. J. M. gives ample reasons which prove that the geologist, if he trenches upon the domains of the antiquarian, does not do so without much advantage to the latter, especially in these days of Drift discoveries, which, by the bye, have carried the antiquarian back to a human period of which he formerly had no conception. It is to be hoped that the geologist and the antiquarian may pursue these interesting modern discoveries in a spirit of wholesome rivalry, inasmuch as their so doing will conduce much to the elucidation of an obscure period, both historically and geologically.

I am, Sir, your obedient servant,

Ernest P. Wilkins, F.G.S.

Newport, Isle of Wight.

Mammalia from Maccagnone Cave.

Sir,—In the table professing to show "the association of the earliest evidences of the human race with remains of extinct and recent Mammalia," p. 228 of the June number of the 'Geologist,' I observe that the following species are attributed to the Grotto of Maccagnone, in Sicily, for the original description of the contents of which I am responsible:—1. *Felis* *spelæa;* 2. *Ursus spelæus;* 3. *Hyæna spelæa;* 4. *Bos primigenius;* 5. *Hippopotamus major;* 6. *Cervus megaceros:* making six out of the eight species assigned to Maccagnone.

These six identifications are simply imaginary; not one of the species, so far as I am aware, having been as yet mentioned on authority, as occurring in the Grotto of Maccagnone.

Such a wholesale manufacture of species, in a case of such gravity, requires no comment.

Your obedient servant,

London, June 23, 1862. H. FALCONER.

Discovery of a Human Skeleton and other Remains in the bed of the River Soar, at Leicester.

On the western side of the town of Leicester there is an old bridge, known as the "Bow Bridge." It has recently been taken down for reconstruction; during the progress of the work the stream has been stopped, and a dam thrown across the channel north and south of the bridge, leaving the bed of the river dry. The upper surface was a black, muddy, alluvial deposit, but this being penetrated, the pure Drift gravel presented itself. This gravel lies immediately on the abraded surface of the Upper Keuper Sandstone, which here dips away under the town towards the Liassic hills on the eastern side. In excavating on the east side of the old bridge for the new foundations, and digging in the bed of the river, the workmen came upon ground in the Drift of a mixed character, gravel and silt. After digging out three feet of this, they came upon a human skeleton lying face upwards, the knees drawn towards the head. It was nearly entire, a few of the vertebræ and the smaller bones of the hands and feet only are wanting. Near this skeleton were found the skull of a horse, ox horns, and other bones.

The old bridge is of some antiquity, and is supposed to have been erected in the twelfth century. The road to which it leads is the *Via Vicinalis* of the old Roman town of Ratæ, and leads to the "Home Way," another Roman road near Leicester. Over this bridge Richard the Third rode to the field of Bosworth, and his body is said to have been thrown over the bridge into the river by the multitude. Be this as it may, the navvies and common people firmly believe this skeleton to be the remains of that monarch; but as Richard's body was "hacked to pieces," and his age at his death was about thirty-five, and as the bones bear no appearance of being "hacked," and the last molar being still in its socket, no weight can be given to such an impression. Certainly Richard the Third had cut his "wisdom teeth."*

JAMES PLANT.

23rd June, 1862.

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* These remains have been transmitted to us for inspection. It is a young, and seemingly not adult, woman's skeleton.—ED. GEOL.

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

Manchester Geological Society.—*April* 29.—1. "On the Geology of the Railway between Hyde and Marple." The length of the line is seven miles, and some of the sections are as much as sixty feet in depth. It trends in a direction nearly coincident with the line of strike of the rocks. The country through which it passes undulates very much, so that the line in places crosses, at a height of more than a hundred feet, valleys worn out by denudations, probably, the author thinks, at the close of the Pleistocene age, as Drift-beds cap their summits. The geology of the railway may be set down as belonging to two widely-separated formations—the Lower Coal Measures and the Pleistocene.

Going along the line from Hyde, about two miles from the town, a thin-bedded argillaceous sandstone rises, overlying beds of shale. No organic remains have been found in it. The dip is on the right-hand side, in a direction nearly N.W., and at an angle of 10 or 15 degrees. Ironstone bands, several inches in thickness, frequently alternate with the shales, and along the whole length of the line these beds are not lost sight of. Towards Marple they have been affected by dislocations, and about a quarter of a mile beyond the aqueduct a downthrow fault of several feet is seen. Near Romilly the gullets are deeper, and the shale-beds are succeeded by those ripple-marked flag-stones. Over these beds lie masses of sandstone rock of coarser texture, containing imperfect impressions of Calamites and Sigillariæ. Two miles further on this rock is succeeded by one of a conglomerate character, and very hard,—the matrix being of a light grey colour, the imbedded pebbles red.

Near Hyde, where the shales first come to view, they contain fragments of Lepidodendra and Neuropteris, with numbers of *Spirorbis carbonarius* and Cyprides, in company with several species of *Anthracosia:* the whole so commingled as to show they shared a common habitat.

The *Anthracosia* found in the ironstone bands are interesting, from the fact that numbers show the interior of the valves, and consequently expose the hinge—a feature which is valuable in settling the various opinions maintained as to the habits of these mollusca. In tracing these apparently freshwater shales towards Marple, we find a change towards marine conditions, *Goniatites*, *Avicula-pectens*, etc. being mixed up with the *Anthracosiæ*.

This fact, the author considers, goes to prove that the *Unio* or *Anthracosia*, formerly regarded as a freshwater shell, was in reality a marine one that lived in shallow and brackish waters.

The Drift deposits which overlie the Carboniferous beds above described, are of the general character. Not much Till is met with until the aqueduct at Marple is crossed, where these beds contain huge boulders of porphyry, granite, syenite, etc. The boulders are generally rounded; the larger ones being scratched and striated. In a section about two miles from Hyde the Drift beds are cut through to a depth of thirty feet, and consist of beds of sand and clay alternating with each other, and containing marine shales, *Tellina*, *Cardium edule*, *Turritella*, *Terebra*, and *Astarte*. The author considers these beds are a continuation of the fossiliferous sands on the Stockport and Woodley Line, formerly described by him.

Rich beds of calcareous marl, sometimes several feet in thickness, are sometimes seen capping the Drift deposits.

2. "On the North Staffordshire Corn Field." By Mr. John Bradbury, jun. The strata of this field were minutely detailed, and a section given, with their measured thicknesses.

3. "On an improved Safety-Cage for Miners." By Mr. T. Farrimond.

Royal Institution.—*March* 7.—"On the Distribution of Northern Plants." By Professor D. Oliver. The discourse referred primarily to the botanical evidence bearing upon the hypothesis advanced by Professors Unger* and Heer† of an Atlantic communication between Europe and America at some period of the Tertiary epoch. The close analogy which is to be traced between the Miocene Flora of Central Europe and the existing Flora of the Eastern American States, these authors conceive can only be explained by assuming such direct overland connection of the two Continents.

The speaker explained the basis upon which comparisons between two recent floras and between a recent and a fossil flora should rest, referring to the peculiar conditions which affect the latter comparison owing to the imperfect and partial character of the fossil element. The general character of the Tertiary Flora of Central Europe was described. In the Tertiary beds of Switzerland, according to Professor Heer‡ about 800 species of Phanerogamia have been discovered, referable to 197 genera (exclusive of *Phyllites*, *Carpolithes*, etc.), of which number 154 still exist. Of these genera—

76 are common to the Swiss Tertiary, and to the present flora of . .	Europe.
77	Japan.
88	Ditto, States, America.
120	Europe and Asia (taken together, and including Japan).

It is to be noted that the 77 of Japan include 26 not occurring in Europe: amongst them several forms highly characteristic of the Tertiary, as *Glyptostrobus*, numerous *Fici*, coriaceous-leaved oaks and *Lauraceæ*, *Juglandeæ*, *Liquidambar*, etc.

The genera, common to the Swiss Tertiary and the United States, which are not found also in the Old World are *Sabal*, *Taxodium*, *Bumelia*, *Liriodendron*, *Ceanothus*, *Ptelea*, and *Carya*. But in respect to these 7 it was observed that at least 5 were very doubtful determinations. The 9 largest orders of the 'Flora Tertiaria Helvetiæ' are *Leguminosæ*, *Amentaceæ*, *Cyperaceæ*, *Proteaceæ*, *Lauraceæ*, *Gramineæ*, *Coniferæ*, *Compositæ*, and *Aceraceæ*. Of these Orders 3 are included in the 9 largest of Europe, 4 in the 9 largest of the United States, and 6 in the 9 largest of Japan, while the remaining 3 of the Tertiary, not included in the 9 largest orders of Japan, are much more largely developed in Japan than in the United States. They are *Lauraceæ*, *Aceraceæ*, and *Proteaceæ*.

The proportion of ligneous to herbaceous species in the above floras was alluded to. Heer estimates ligneous plants to have formed about 66 per cent. of the Phanerogamic vegetation of the Tertiary in Switzerland. The speaker considered this estimate as too high, believing that sufficient allowance had not been made for the advantages that ligneous plants, which are often tall-stemmed, possess over herbaceous species in securing access of their leaves and débris to the waters in which they had been floated, and ultimately preserved. He admitted, however, that ligneous species were relatively very numerous in the vegetation of the Tertiary period. The proportion of ligneous plants he estimates in the existing flora of Japan at near 40 per cent., in the Southern States 22, Northern States 18, Europe 9 to 12.

* 'Die versunkene Insel Atlantis.' † 'Flora Tertiaria Helvetiæ.'

‡ The Tertiary data were throughout derived from the 'Flora Tertiaria Helvetiæ' of Professor Heer.

The intimate relationship traceable between the Tertiary and Japanese floras in the numerous characteristic types common to both; the issue of the ordinal and generic comparisons given above; the larger proportion of ligneous species in the Japanese than in the Eastern American flora; and the number of types peculiar, at the present day, to Eastern America and Eastern Asia, compared with the few restricted to Europe and America, the speaker contends, favour the view advanced by Professor Asa Gray in reference to plants and by Mr. Darwin as to animals, viz. That the migration of forms to which is due the community of types in the Eastern States of North America and the Miocene of Europe, took place to the North of the Pacific; an overland communication, it may be supposed, having existed during the Tertiary time somewhere about Behring's Straits or the line of the Aleutian Islands. This view is confirmed by the occurrence of Miocene vegetable remains in North-west America (including genera yet growing in Japan but lost to America), which prove, further, the temperature of these latitudes to have been at that time sufficiently high to have permitted their existence so far north.

The evidence in favour of the 'Atlantis' might, moreover, be expected to have been more marked in the existing vegetation of the Atlantic Islands than is the case. Professor Heer points out the genera *Clethra*, *Bystropogon*, *Cedronella*, and *Oreodaphne* as common to the Atlantic Islands and America. Japanese species, however, have been described of *Clethra* and *Cedronella*; and Messrs. Webb and Berthelot limit *Bystropogon* to Atlantic Island species. *Oreodaphne* occurs in South Africa and adjacent islands.

A connection between these Islands and Europe, at perhaps a late period of the Tertiary, may be considered as highly probable from the predominance of Mediterranean forms in their flora. The few genera characteristic of the Tertiary which they possess may have been derived during this connection; but the hypothesis that a continent should have extended westward as far as America, the speaker considered the available botanical evidence did not in the least substantiate.

Royal Institution of Great Britain.—*May* 23.—"On Coal." By Warington W. Smyth, Esq., F.R.S. The speaker selected one portion only of this large subject; and, neglecting chemical and statistical and mining particulars with reference to this important mineral, confined himself to the physical conditions under which it is found to occur.

Mr. Smyth described the nature of the various substances with which the coal is associated; and comparison was made between the total thickness of carboniferous rocks or coal-measures of different districts, as well as between the total thickness of coal (in the aggregate of the seams); hence we have one reason for not estimating the value of a coal-field merely by its area, as laid down in a geological map. Thus, the well-known Durham field, with a thickness of measures of about 2000 feet, has a total thickness of coal of 50 feet; the Derbyshire, 2000, and almost twice the thickness of coal; the North Staffordshire, 6000 feet of measures, and 130 of coal; whilst the South Welsh and Saarbrücken fields exhibit thicknesses of 12,000 to 15,000 feet, with a proportionate increase, especially in the latter, of coal. A second reason for mistrusting area as a criterion of the importance of a coal-district, is the various forms into which the coal-measures have been thrown or moulded by agencies operating at a later date in the earth's crust, whence some districts may exhibit by outcrops an indication of the full amount of their entire contents, whilst in others the beds pass with a gradual inclination beneath newer formations, through which they may nevertheless by sinkings be accessible, as in the case of the vast accession of mineral wealth added, in the last twelve years, to the Westphalian coal-field, by the explorations carried through the covering of cretaceous rocks which clothe the northern side of the coal-field. The remarkable pit lately completed by the Duke of Newcastle, at Shireoak, was another example. At a distance of several miles from any visible coal-measures, it had pierced the New Red Sandstone and Magnesian Limestone, and reached the "top-hard" coal at 515 yards in depth.

Referring to the principal families of plants which are found either in, or associated with, the coal, he endeavoured to show that their occurrence throws a light on the origin of the coal-seams, a knowledge which becomes an important guide in enabling us to judge of the continuity of some fields. The position of the stigmaria in the under-clay or floor of the seam, and of the stems of sigillaria, lepidodendron, calamites, etc., in the roof strata, point to the probability of the growth of the vegetable matter *in situ*. The existence of numerous upright stems, and especially those occurring so often and so dangerously to the miners in the roof of certain coals, is a strong confirmation of the gradual depression of the tract in which these plants grew; and Göppert has shown that the careful examination of a number of seams proves the existence in the coal itself of every family of plant which has been met with in the coal-measures.

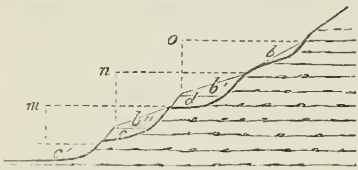
Thus much had referred to the true Carboniferous period, in which it is commonly supposed that a vigorous vegetation first arose, but the speaker described his finding, a few months since, in the Laxey lead and copper mine, in the Isle of Man, at 120 fathoms deep, a seam of anthracite coal, three to four inches thick, in the midst of ancient schists, probably Lower Silurian. He then noticed the coaly and lignitic beds in newer formations, especially the Tertiary "brown-coal," which in Continental, and especially in Southern Europe, attains to great importance. The excellent preservation of the vegetable remains in the lignite has enabled Professors Unger and Heer to make comparison with existing floras; and these authors show that the Tertiary flora had nothing in common with our present flora in Europe, but had an extraordinary resemblance to that of modern North America. This was especially to be noticed in closely similar species of the genera *Liquidambar*, *Liriodendron*, *Pavia*, *Nyssa*, *Robinia*, *Taxodium*, *Sequoia*, *Juglans*, *Glycyrrhiza*, *Cercis*, *Laurus*, *Rhododendron*, *Cissus*, and certain oaks and pines. There was hence, the speaker thought, no retreating from the conclusion, that at that portion of the Tertiary period a land communication existed between America and Europe. Fragments of that land, with relics of the same Tertiary flora, he considered still existed in Iceland and the Azores, with their *surturbrand* and lignites; and thus the existence of that Atlantis, which is generally set down as a dream of the poets, was, according to his views, supported by the studies of the geologist. A relation of this kind at a comparatively recent period, throws a light on the causes of phenomena belonging to an earlier epoch, and enabled the forming of conclusions, if not upon the absolute contemporaneity of certain beds or groups of coal-measures, at all events upon the physical connection within a given period of the agencies which were forming coal not only in the various fields of Europe, but also in North America.

Glasgow Geological Society.—*May* 10*th*.—The members had an excursion to the hills of Greenock and to Loch Thorn. The hills, generally speaking, are of igneous rock; towards their front they were found to be principally of a fine variety of amygdaloids, containing nodules of crystallized quartz, and silicates of magnesia, with indications of zeolitic minerals. Near Loch Thorn the rocks become compact greenstone, and dark-coloured porphyry. When the excursionists arrived at the eastern extremity of the Loch, they came suddenly upon a fine section of the "Ballagan limestones," tilted up nearly vertical, with regular divisions of shales, which have lost much of their schistose character, and are regularly traversed by thin veins of calcareous spar—apparently a variety of satin spar. The remarkable uplifting of these strata is the effect of a trap dyke, visible close beside them, also a portion of an overlying sandstone converted into "kingle" (a mining term for indurated sandstone) by igneous action. At the opposite extremity another trap dyke appears, which apparently has effected this change in the sandstone. These sandstone beds are at the same angle as the other strata. The burn below exhibits the Old Red Sandstone *in situ*, and Red Marl clays also much altered by igneous action, with a number of fine specimens of Red Sandstone conglomerates. In going up the burn the route is over a bed of similar limestone, and the district is well worthy of future detailed examination. One remarkable feature of these Ballagan beds was the rounding of the vertical limestones, being of a flattened spherical shape, evidently the result of weathering and scaling off at the exposed surfaces. These Ballagan beds occur some miles distant at Ballagan, Campsie Hills, and a range of fine sections occurs at Auchenreoch Glen, Dumbarton; with this difference, at Loch Thorn the crystallized veins of calcareous spar are *carbonate* of lime, while at Auchenreoch and "Ballagan" they are *sulphate* of lime (gypsum). Loch Thorn is a fine sheet of water, partly artificial and partly natural. It supplies Greenock and its works with water.

Since the discovery of the Ballagan beds at Loch Thorn, at the time of the excursion, one of the members has visited the district, and having gone a considerable distance up the burn, reports that other important appearances of the Ballagan strata present themselves in very fine sections, and that the igneous cause of their upheaval and vertical position is exhibited lower down the burn than was suspected during the first rapid view taken of the strata. No doubt a more searching investigation will take place during the summer, and should any important facts present themselves in relation to the relative position, etc., of the Ballagan beds with the Old Red Sandstone and coal-measures, the information will be forwarded to the 'Geologist.'

Royal Society.—19*th June*.—"On the Loess of the Valleys of N. of France and S. of England." By J. Prestwich, Esq., F.R.S. During a recent visit to France the author made observations which have enabled him to draw conclusions as to the formation of the Loess. In this communication the author first refers to the Loess of the Rhine, concurring with Sir Charles Lyell in attributing its origin to river inundations, but draws different conclusions as to the mode and circumstances of its deposit.

The greatest difficulty that has been felt in attempting to understand the spread of the Loess in England and France has been the great difference of the levels at which they are found, these often being from 100 to 300 feet above the present river-courses—heights to which no river-inundations could attain in the present valleys. But of the former existence of less deeply-excavated valleys in the present valley-sites, the covering of Loess might lead to the inference; and notwithstanding the extension of the Loess over the loftier ground flanking the valleys, such areas appear to be always bounded by higher hills, forming a barrier restricting the limits of the floods. The author's opinion is that the Loess is, like the high- and low-level gravels, always connected with river-valleys; and if, instead of starting at the present low-levels, the ancient valleys be taken at the level the author in his former communication showed them to have had at the period of the high-level gravels, that is at from 100 to 200 feet above the floors of the present valleys, the difference of level then of the upper deposits of Loess to be accounted for will be diminished to 100 or 150 feet, —a difference still considerable; but, on the other hand, these extremes are not always attained. At all events, this brings the whole of the Loess within the possible range of inundations of the old Pleistocene rivers at different periods according to their age; the higher beds having been deposited by the overflowings in the earliest periods and before the excavation of the present river-valleys, the lower beds after the present valleys had been formed, but while the old meteorological conditions still prevailed. These deposits of Loess thus furnish a measure of the volume of water anciently brought down by the rivers during floods, and show how very far they exceeded their present representatives, and how great must have been their erosive action. Flood-deposits will always consist of shingle in the river channels; sand in sheltered places; fine silt over the area where the flood waters repose. In this manner the author considers the high- and low-level gravels and the Loess of all the levels to have been formed.



b b′ b″ Loess; *d* a high-level gravel; *c c′* low-level gravels; *m, n, o,* the levels to which the river rose during inundations at different periods.

This flood-origin of the Loess being admitted, it follows that as that deposit is found at 50 to 100 feet above the highest beds of gravel, the floods of these periods must have risen like those of the Arctic regions, but to even a greater extent (50 to 100 feet), above their summer levels. The fluviatile shells found in the gravels and Loess were stated to be identical.

Geological Society of London.—*April* 16, 1862.—1. "On the Position of the Pteraspis-beds, and on the Sequence of the Strata of the Old Red Sandstone Series, in South Perthshire." By Professor R. Harkness, F.R.S., F.G.S.

At the Bridge-of-Allan the lowest beds seen of the Old Red Series are (1) conglomerates of trap-rocks, overlaid by (2) grey sandstone passing upwards into red sandstone. These grey sandstones have afforded to Mr. Powrie a *Pteraspis* (perhaps *P. rostratus*), and fragments of *Cephalaspis* have also been found in them. Next above come (3) purple shales (at Craig Arnhall); then the brown sandstones (4) of Downe Castle; and lastly at Laurick, grey sandstones (5) again. These all have a N.W. dip, as seen along the Teith. From about Laurick to Callander the strata are best seen in the Keltie burn. They have a S.E. dip, and form the other, but steeper, side of a synclinal trough (about twelve miles wide); and here grey sandstone (5), (4) brown sandstone (at Bracklin Linns), (3) purple shale, (2) red and grey sandstone, and lastly (1) a conglomerate (here composed of felstone) present an analogous succession to that between Laurick and the Bridge-of-Allan. At Callander the conglomerate lies almost vertically against the metamorphic Lower Silurian rocks of the Grampians, trap-rock intervening. The author estimates that the Old Red strata have a thickness of 7000 feet.

2. "On the Western Extremity of the London Basin; on the Westerly Thinning of the Lower Eocene Beds in that Basin; and on the Greywethers." By William Whitaker, Esq., B.A., F.G.S., of the Geol. Surv. Great Britain.

In the first part of this paper the author described certain outliers of Tertiary strata in the neighbourhood of Bedwin and Savernake (or Marlborough) Forest, in Wiltshire, where in the course of the Geological Survey of the district he found that both the Woolwich and Reading beds and the London Clay gradually thinned out westward, until merely 3 or 4 inches of the latter alone remained between the Bagshot beds and the Chalk. Further eastward these are probably in direct apposition. The superficial loam and clay with unworn flints of the Chalk district along the northern side of the London Basin were then described.

In the second portion of the paper it was shown, both from the published results of Mr. Prestwich's researches and later observations made in the progress of the Geological Survey, that the Thanet Sands thin out westwardly, from a thickness of about 85 feet in the Isle of Thanet, to about 35 feet at London, and to 3 feet at Chobham, disappearing altogether near Epsom. The Woolwich and Reading beds include the Blackheath Pebble-bed, according to the author: at Herne Bay Mr. Whitaker gives these beds a thickness of about 50 feet, at Croydon 45 feet, at New Cross 54 feet, at London from 40 to 70 feet, at Ealing 60 feet, at Hanwell 75 feet, at Chiswick 90, at Reading about 50 feet, and near Great Bedwin, in Wiltshire, only 15 feet. The London Clay, with its basement-bed, is nearly 480 feet thick at Sheppey, 400 feet at London, 370 feet at Reading, 20 to 60 feet near Newbury, only 15 feet near Great Bedwin, and is represented by a few inches of its pebbly basement-bed in Marlborough Forest.

The third part of the paper treated of the Greywether Stones of Wiltshire, which the author believes must have come from the Bagshot Sand, which alone of the Tertiary beds is present there in sufficient thickness to yield these large and numerous masses of bedded rock.

3. "On a Clay-deposit with Insects, Leaves, etc., near Ulverston." By John Bolton, Esq.

The deposit described in this paper was a greenish-drab clay, lying beneath a capping of locally derived drift and rubble of varying thickness, upon the Mountain-limestones of Low Furness. It was met with during the progress of drainage-works undertaken by the Lindal-Cote Iron-ore Company. At one locality, the clay is 93 feet from the surface, and has a thickness of 15 feet; it seems to fill a basin in the limestone. The imbedded plant- and insect-remains and its contained Diatomaceæ proved the deposit to be of lacustrine origin. Fragments of wood occurred in it, stained blue by phosphate of iron. It appeared probable from the depth at which the clay was buried beneath locally derived material, upon a comparatively level surface, that it was of great antiquity, though possibly younger than the glacial epoch.

May 7th, 1862.—The following communications were read:—

1. "Note respecting the Discovery of a new and large Labyrinthodont (*Loxomma Allmani*, Huxley) in the Gilmerton Iron-stone of the Edinburgh Coal-field." By Professor T. H. Huxley, F.R.S., Sec. G.S.

Looking over the vertebrate fossils from Burdie House and Gilmerton in the University Museum, Edinburgh, Professor Huxley came upon some reptilian specimens—a fragment of the hinder part of the upper wall of a cranium and some sternal plates of a Labyrinthodont, which, from the obliquity of its orbits, he names *Loxomma*. The skull would be about 14 inches long if perfect; and the animal about 6 or 7 feet.

2. "Note on a new Labyrinthodont (*Pholidogaster pisciformis*, Huxley) from the Edinburgh Coal-field." By Professor T. H. Huxley, F.R.S.

The specimen on which this new form has been determined was placed in the British Museum by Sir P. Egerton and Lord Enniskillen, who recognized it as Reptilian. Mr. Davis, of the British Museum, drew Mr. Huxley's attention to it as being probably Archegosaurian. It is not well preserved, but on careful study proves to be an amphibian allied to *Archegosaurus;* differing, however, from it in the form of the head, the extent to which the ossification of the vertebral column has proceeded, and in the character of the dermal armour. This animal was about 44 inches long.

3. "On the Land Flora of the Devonian Period in North-eastern America." By J. W. Dawson, LL.D., F.G.S.

First noticing what was formerly known of the Devonian Plant-remains in the States of New York and Pennsylvania (Hall, Vanuxem, and Rogers), in Gaspé (Logan), in New Brunswick and Maine (Gesner, Robb, Bennett, Hartt, Matthew, and Hitchcock), the author stated that with Messrs. Hartt, Matthew, and others at St. John's, he had lately examined the productive localities near that city, and is now enabled to add largely to the account of the Devonian plants he had already published in the 'Canadian Naturalist,' vol. vi. 1861. He now enumerates about 70 species (32 genera) of plants as occurring in the Upper Devonian of Pennsylvania, New Brunswick, Maine, New York, and Gaspé, in the Middle Devonian of New York and Gaspé, and in the Lower Devonian of Gaspé. Of these 70 species, two (*Psilophyton princeps* and *Cordaites angustifolia*) are referred also to the Upper Silurian of Gaspé; and 10 (not including these two) reappear in the Carboniferous strata. The Devonian Flora much resembles in general facies that of the Carboniferous period. In the Lower Devonian series the underclays are filled with the rhizomes of *Psilophyton,* in the Upper Devonian with *Sigillariæ* and *Calamites* (as in the Coal-measures). The Devonian Flora is less perfectly preserved than that of the Coal-measures, and is probably as yet very imperfectly known; it presents more resemblance to the floras of the Mesozoic period and of modern tropical and austral islands than the Coal-plants present. The facies of the Devonian flora in North America is very similar to that of the same period in Europe.

Among the Devonian plants of North-east America, Dr. Dawson recognizes an angiospermous dicotyledon (*Syringoxylon mirabile,* nov. gen. et sp.), established on a fragment of fossil wood collected by Professor James Hall from a limestone of the Upper Hamilton Group, at Eighteen-mile Creek on Lake Erie.

4. "On some Upper Eocene Fossils from the Isle of Wight." By Professor Dr. F. Sandberger. In a Letter to W. J. Hamilton, Esq., For. Sec. G.S.

The result of Professor Sandberger's examination of a collection of these fossils, carefully named by Mr. F. E. Edwards and forwarded by Mr. Hamilton, has been to confirm him in his opinion that the upper beds at Hempstead, Isle of Wight, are the exact equivalent of the marine beds at Weinheim, Jeurres, and Bergh (*Reupélien inférieur,* of Dumont). The freshwater limestone of Bembridge and Sconce appears to correspond to the beds at Buxweilar (Alsace) and Abstadt (Baden); and the fossils from Headon Hill and Colwell Bay probably belong to the level of Dumont's *Tongrien inférieur* (Lethen and Westergeln) *et supérieur* (Marnes supérieur au gypse).

May 21.—The following communications were read:—

1. "On the Metamorphic Rocks of the Banffshire Coast, the Scarabins, and a portion of East Sutherland." By Professor R. Harkness, F.R.S., F.G.S. The coast-section from Gamrie to Buckie was first described; it consists mainly of folded gneiss and grauwacke sandstone and shale, with

underlying quartz-rock of great thickness, conformable, and folded with it, and seen in anticlinals at Melrose, Banff, and Dunidich, and still more in an arch between Cullen and Buckie. Two folds of limestone, obscurely stratified and not persistent, occur with the schists at the Burn of Boyne and Dunidich. The dykes of syenite, of granite, and of serpentine (Portsoy) were also pointed out in this section, as well as two outliers of the Old Red deposits at Dunidich and Cullen. The metamorphic rocks above mentioned have a predominating south-east dip, and the folds hang over to the north-west; but the author regards these strata as holding a reversed position, the gneissose and grauwacke strata being really the uppermost of the series, as in other parts of the North of Scotland. The section from the sea at Berridale, across the Scarabins to Strath-Naver, was next described. Here the granite of Bean-na-aiglesh succeeds to the Old Red Sandstone of Berridale, and is succeeded by the gneiss and folded white quartz-rock of the Scarabins. From the Scarabins to Strath-Naver granite and gneiss alternate in laminar masses, dipping south-east towards the Scarabins, here and there bearing unconformable outliers of Old Red Sandstone. In this case also the author pointed out that a reversed dip obtained, by which the really uppermost gneissose rock was made to appear lower in position than the quartzite. Professor Harkness further alluded to the conformability of the granite with the strata in this district, and to the probability of its being rather the result of an excessive amount of metamorphic action than of plutonic origin.

2. "On the Geology of the Gold-fields of Nova Scotia." By the Rev. David Honeyman. (Communicated by the President.) The author, at the request of the Provincial Government Commission for the International Exhibition, made some observations on the auriferous rocks at Allen's and Laidlow's farms, near the junction of the Halifax and Windsor and the Halifax and Truro railways. He found chloritic schist, with vertical auriferous quartz-veins, and a gold-bearing horizontal quartz-vein (the "barrels" of the miners) lying on the schist and overlaid by quartzite and gravel. By the neighbouring railway sections the chlorite-schist is seen to alternate in broad bands with quartzite, and to be associated with granite. The author thinks there is reason to believe that the quartzite may be of Lower Silurian age.

3. "On some Fossil Crustacea from the Coal-measures and Devonian Rocks of New Brunswick, Nova Scotia, and Cape Breton." By J. W. Salter, Esq., F.G.S., of the Geol. Surv. Great Britain. One of the Devonian fossils is apparently allied to the Stomapods, and is named *Amphipeltis paradoxus* by Mr. Salter; it was obtained by Dr. Dawson near St. John's, where it occurred with plant-remains; another Crustacean fossil from the same locality is a new *Eurypterus, E. pulicaris*. Other remains of *Eurypteri* have been sent also by Dr. Dawson, from the coal-measures of Port Hood and the Joggins; and with these a new Amphipod, *Diplostylus*, having some characters of alliance with *Typhis* and *Brachyocelus*.

4. "On some species of *Eurypterus* and allied forms." By J. W. Salter, Esq., F.G.S., etc. After alluding to the late and complete researches on *Eurypterus* by Dr. Wieskowski and Professor J. Hall, Mr. Salter explained some formerly obscure points in its structure, and proceeded to describe the *E. Scouleri*, Hibbert, from the Carboniferous limestone of Scotland, and the Upper Old Red Sandstone of Kilkenny; the *E.* (*Arthropleura*) *mammatus*, sp. nov., from the Upper Coal-measures near Manchester; and *E.?* (*Arthropleura?*) *ferox*, sp. nov., from the Coal-measures of North Staffordshire.

5. "On *Peltocaris*, a new genus of Silurian Crustacea." By J. W.

Salter, Esq., F.G.S., etc. Of this form an imperfect individual, from the anthracite-shales (Llandeilo flags) of Dumfriesshire, was formerly described by the author as *Diethyrocaris? aptychoides.* Better specimens enabled him to distinguish it as a new generic form belonging to the Phyllopods, not far removed from *Hymenocaris* and *Dithyrocaris.* A fragment of another larger form, from the same locality, is described by the author as *Peltocaris? Harknessi.* Mr. Salter also explained his views of the relationship of the palæozoic *Phyllopoda,* among themselves and with the recent forms, and illustrated them by a diagram in which they were arranged in chronological succession.

6. "On a Crustacean Track in the Llandeilo Flags of Chirbury, Shropshire." By J. W. Salter, Esq., F.G.S., etc. This track consists of numerous short, narrow, oblique, chisel-shaped imprints, on the ripple-ridges of the slab; and, according to the author, it must have been caused by a small Crustacean with a bifid telson or prong-like tail. To a like agency Mr. Salter refers similar markings described by M. Brebisson as occurring in the Lower Silurian Sandstone of Noron in the Falaise (Normandy).

June 4.—The following communications were read:—

1. "On the disputed affinities of the Purbeck Mammalian genus *Plagiaulax.*" By Hugh Falconer, M.D., F.R.S., F.G.S.

Referring to his former description (Journal Geol. Soc , vol. xiii. p. 261, etc.) of *Plagiaulax* as a rodent form of marsupial, having affinities with the existing *Hypsiprymnus;* and to the very different opinion of its relationship expressed by Professor Owen in the 8th edition of the 'Encyclopædia Britannica,' where it is said to have been "a carnivorous marsupial," Dr. Falconer then reviewed the dental characters of *Plagiaulax* in detail. The incisors, in regard of number, order of suppression, collateral position, and relation to the premolars, correspond exactly with the type of marsupial herbivora, and are wholly at variance with the carnivorous type; and he argued that Professor Owen's argument drawn from *Thylacoleo* has no bearing on the incisors of *Plagiaulax,* and gives no support to the carnivorous inference. Of the premolars, after a full comparative re-examination (in agreement with his already published views) he finds reason to regard the carnivorous deduction from the shape of the premolars to be altogether untenable.

The form of the lower jaw of *Plagiaulax* having been regarded by Professor Owen as conforming with the carnivorous type, the author showed that in the non-carnivorous *Cheiromys* (Aye-Aye) and *Phascolarctus* (Koala) a similar form of ramus obtains; and that the coronoid and condyle of the Aye-Aye are not unlike those of *Plagiaulax*; whilst in existing predaceous marsupials the condyle has a different form. The author considered that *Plagiaulax* was essentially a phytophagous marsupial.

2. "On some Fossil Plants from the Hempstead Beds, Isle of Wight." By the Rev. Dr. O. Heer, Professor of Botany, Zurich. With an introduction, by W. Pengelly, F.G.S.

These plant-remains, from the Hempstead Series, consist of seeds, cones, leaves, and twigs, and are referable to ten species, four of which have been found lately at Bovey Tracey also, namely, *Sequoia Couttsiæ,* Heer, *Andromeda reticulata,* Ettin., *Nymphæa Doris,* Heer, and *Carpolites Websteri,* Brongn. The other species are *Cyperites Forbesi,* n. s., *Nelumbium Buchii,* Ettin., *Carpolites globulus,* n. s., *Chara Escheri,* Braun, and *Ch. tuberculata,* Lyell, var. Professor Heer notices that six of the above-named species are found also in the Lower Miocene (Tongrian and Aquitanian) of the Continent; and that this flora, as far as represented, seems to indicate truly freshwater conditions for the formation in which it is found.

3. "On Glacial Surface-markings on the Sandstone near Liverpool." By G. H. Morton, Esq., F.G.S.

The author here noticed the occurrence of glacial grooves and scratches at—1st, Toxteth Park, the direction of the striæ being N. 42° W., at 120 feet above the sea; 2nd and 3rd, at Boundary-lane and New-road, Kirkdale, the striæ being N. 15° W., and at about 80 feet above the sea.

NOTES AND QUERIES.

Corylaceæ in a bed of Lignite under Silt.—The following brief description and sketch of a deposit in which I recently found nuts of the Corylaceæ, those of the *Corylus Avellana*, or common hazel-nut, may interest your readers.

The lignite bed in which the said nuts are observed, is the part of the embankment of a small stream or burn in the neighbourhood of the village of Whiteinch, forming the boundary between two counties. The lignite bed appears from its position, the lower portion being on a level with the water of the burn which when in flood rises a little above it, to crop out and to be a portion of the lignite strata several feet under the surface. The embankment is only about six feet in height. In the sketch (*a a*) represents fine sand containing organic remains, undoubtedly cainozoic, fragments (teeth, etc.) of mammalia, coprolites, and small fossil portions of flora, perpendicular in position. Mixed with the sand I found fragments of quartz, round in shape, and belonging to that formation termed locally the till, or drift. And I may here remark that quartz balls from the drift, smoothed and perfect in form, are frequently seen in the walls or Dikes in this neighbourhood. Under a portion of the sand or clay (*b*) and the lignite bed (*c c*) the lignite is mixed with black mud, and contains flora not in a fossil state, as is the case with the fragments in the sand (*a a*) but in a state almost perfect, *i. e.* the portions of the hazel or birch branches are not fossilized, and have only lost a small portion of their bark; the position of the stems is horizontal.

Intermixed with the mud of the lignite and almost on a level with the burn, are the nuts in abundance, and not in the least subject to any pressure from the lignite above them, but at the same time prevented by the mud from being removed by the water of the stream when in flood. The black dots in the sketch shows their position in the lignite, which like the lignites of the Continent exhibit the true dicotyledonous structure.

This remarkable deposit appears to be a fluvio-marine bed, or fluviatile accumulation. The lignite is undoubtedly still forming, and the position of the nuts makes me imagine that the force which pressed the silt (*a a*) down upon the vegetable remains was the Drift, which appears from the position of the clay (*b*) to have come in a northern direction. After passing under a bridge, the Dumbarton road, the stream joins the Clyde, which doubtless originated the low long valley-terrace, of which the lignite bed just described forms a part. "These terraces," Mr. Page remarks, "have long attracted attention, and point to a time when many of our fertile valleys were chains of lakes and morasses, which have been drained and converted into alluvial land by the natural deepening of the river channels." The black putrid mud in which the lignite is embedded, shows, in my humble opinion, what I could not before understand, how quartz pebbles have been introduced into coal. The mud has contained quartz pebbles, and been subjected to gradual but strong pressure, and if I may use the term, turned into coal, which retains the quartz pebbles that ever and anon crack with a loud noise in our domestic hearths.—P. S., *Whiteinch, near Glasgow.*

Classification of Animals.—In order that our readers may have the opportunity of examining the latest classification of animals, as expounded by the most advanced school of zoologists, the following table is inserted, which is adapted from the classification of Professors Huxley and Reay Greene (Jukes's 'Manual of Geology,' pp. 376 and 710). The groups to which an R. is attached were classified by Cuvier under *Radiata.*

1. Subkingdom VERTEBRATA.

Province Abranchiata.
Class Mammalia.
,, Aves.
,, Reptilia.

Province Branchiata.
Class Amphibia.
,, Pisces.

2. Subkingdom MOLLUSCA.

Province 1. *Odontophora.*
Class Cephalopoda.
,, Pterofoda.
,, Pulmonogasteropoda.
,, Branchiogasteropoda.

Province 2. *Lamellibranchiata.*
Class Conchifera.

Province 3. *Molluscoida.*
Class Brachiopoda.
,, Polyzoa, R.
,, Ascidioida.

3. Subkingdom ANNULOSA.

Province 1. *Articulata* or *Arthropoda.*
Class Insecta.
,, Myriapoda.
,, Arachnida.
,, Crustacea.

Province 2. *Annulata.*
Class Annelida.

Province 3. *Annuloida.*
Class Scolecida, R.
,, Rotifera, R.
,, Echinodermata, R.

4. Subkingd. CŒLENTERATA.

Class Actinozoa, R.
,, Hydrozoa, R.

5. Subkingdom PROTOZOA.

Province 1. *Stomatoda.*
Class Infusoria, R.

Province 2. *Astomata.*
Class Spongida, R.
,, Rhizopoda, R.
,, Gregarinida, R.

Mammalian Remains.—A considerable quantity of bones and teeth of the extinct mammals has been found in the Ouse valley, in the vicinity of Bedford, during the past month, but the greater proportion were much broken on their removal from the gravel. The new line of railway from Bedford to Cambridge passes through several miles of the Drift, but owing to the low level of the valley hereabouts, the excavations have not been very deep, except in parts worked for ballast. In these spots bones and teeth of the *Elephas primigenius*, *Bos primigenius*, *Cervus tarandus*, and *Equus* have been found: and also some fragments of a tusk of *Hippopotamus major*. No doubt many valuable specimens were flung into the ballast wagons, as a whole acre of gravel was excavated to the depth of several feet at Summerhouse Hill, and removed by railway trucks to form approaches for bridges and viaducts. At this spot the bones were all exceedingly brittle, and we believe but few have been preserved entire. Last week some large portions of the bones of *Elephas primigenius* have been taken out of the lowest gravel of the Biddenham Pit, close to the spot where flint-implements were found last year; and a molar tooth of that animal, which exceeds in size any that have been found whole in that vicinity. This specimen has a grinding surface of eight inches in length, and $3\frac{1}{2}$ inches in width; and the length at the base is fifteen inches. The roots of the tooth were very friable, and a great portion crumbled away, but the specimen notwithstanding weighs $17\frac{1}{4}$ lbs. It is in the collection of Mr. James Wyatt, F.G.S., Bedford.

FOREIGN INTELLIGENCE.

'Silliman's American Journal of Science' for May has an abstract from Capt. Reynolds's forthcoming Report to the United States Government of Dr. Hayden's remarks "On the Period of Elevation of the Ranges of the Rocky Mountains near the Sources of the Missouri River and its Tributaries." The evidence, Dr. Hayden considers, makes it clear that the great subterranean forces which elevated the western portion of the American continent were called into operation towards the close of the Cretaceous period, as that the gradual quiet rising continued without a general bursting of the earth's crust until after the accumulation of the Tertiary lignite deposits, or at least the greater part of them; after the fracture of the surface commenced and the great crust-movements began to display themselves, the whole country continued rising, or at least, though there may have been periods of subsidence or repose, there was a general upward tendency that has continued even up to the present time.

There is also, in the same number, a paper by Sir W. E. Logan, "On the Quebec Group and the Upper Copper-bearing Rocks of Lake Superior," and a "Notice of the Rocks between the Carboniferous Limestone of the Lower Peninsula of Michigan and the Limestones of the Hamilton Group," by Mr. Alex. Winchell, the State geologist of Michigan.

A descriptive account of two sections made across the bed of the Scaldisian system, and of the overlying strata near the city of Antwerp, illustrated with plates, has been communicated by M. Dejardin, Captain of Engineers to the Belgian Academy.

In 1861, M. Dewalque described the constitution of the Eifel system in the basin of Condroz. He has lately added a notice of the same system in the basin of Namur.* The great series of palæozoic rocks well known under Omalin's designation of the "terrain anthraxifère," occupy a large surface in Belgium, slightly elongated from east to west, and parted by the uprise of the schists of the "terrain Rhénan" of Dumont into two

* Bulletin Acad. Roy. de Belgique, 1862.

"massives," or incompletely-separated basins; the southern termed the basin of Condroz, the northern the basin of Namur. The former is remarkable for the thickness of its strata and the undulations which bring the same beds so often to the surface; the latter, of which the different series are much thinner, presents only one flexure of each, constituting the axis of the coal-field. It offers then a symmetrical series in a disjointed basin, of which faults sometimes obscure a portion on one side and sometimes on the other. The beds now investigated by M. Dewalque correspond to those which M. Dumont described in 1830 under the names of "systèmes quartzo-schisteux inférieur et calcareux inférieur;" and which were subsequently united in the 'Carte géologique de la Belgique' under the title of "Système eifelien," corresponding to what is generally known as Middle Devonian.

Admitting the exactitude of the fundamental points of Dumont's classification, M. Dewalque considers the observations of palæontologists must cause some modifications of details, and that it is necessary to lower the boundary between the Eifelian and Condrusian formations, the division of which, Dumont, having only mineralogical character as a guide, has generally set too high.

Dr. C. Malaise, of Gembloux, having collected a series of fossils from the fossiliferous beds of Grand Manil, regarded by Dumont as belonging to the "terrain Rhénan," but afterwards assigned to the Silurian system by M. Gonelet, who stated the occurrence there of *Trinucleus* allied to *ornatus*, a *Calymene* near to *incerta*, *Leptæna depressa*, and five species of *Orthis*. The fossils found by Dr. Malaise have been determined by Professor De Koninck, and are all of Lower Devonian species, *Orthis Murchisonii* and *O. orbicularis* being the predominant forms. The clay-slates and fossiliferous quartzites of Grand-Manil and those of Houffalige and Ardenne, Dr. Malaise believes to belong to the Système Coblentzien of the "terrain Rhénan," these fossil fauna being purely of Lower Devonian.

It is well known that the coal-field of Mons is prolonged subterraneously into France, covered by more recent geological formation, towards Valenciennes, Douai, and Béthune. Of late years researches have been made in the opposite direction, to the north of the basin, in the hope of finding coal. It is not clear on what grounds the probability of the existence of a coal-basin to the north of Lille has been founded; but although five years since, when the subject was brought before the Geological Society of France, this opinion was contested by Dormoy, Delanoue, and Gosselet, a boring was undertaken at Menin, about four leagues from Lille; and this has now been stopped, after having penetrated without success 306 mètres of rock, of which the last 20 consisted of blackish-blue schists.

It is thus clear that further search to the north of the Menin is hopeless. The borings would come upon the Coblentzian rocks towards Thielt, or they would probably meet with the underlying or Gedinnian beds of the Rhénan formation.

REVIEWS.

Further Discoveries of Flint Implements in the Drift. By John Evans, F.S.A. (Extract from 'Archæologia,' 1862.)

The prominent part which Mr. Evans took in a brave and consistent manner at the beginning of the discussion on the important topic of the antiquity of the human race which the early fossil flint-implements evoked, gave him justly the leadership of British antiquaries in this warfare against deeply-rooted prejudices and inculcated opinions, in the same way as Mr. Prestwich took the lead amongst British geologists; and, as we look to the latter for the narration and reduction of new geological facts, we look to receive from the former periodically the antiquarian view of all fresh details and novelties. We do not propose to use our pages, in expressing our sense of the valuable services rendered by Mr. Evans, however justly such encomiums may be due, but we prefer to economize our space by giving without comment a summary of the "finds" not hitherto recorded or but slightly noticed in this journal, and noting the chief topics in this addition to his former excellent paper in the 'Archæologia' of 1860, and which has been noticed by us, Vol. IV. p. 358.

Paris.—Flint-implements have been found by M. Gosse, of Geneva. The pits in which they were discovered are two,—that of M. Bernard, Avenue de la Motte Piquet, No. 61–63 (Champ de Mars), and that of M. Etienne Bielle, Rue de Grenelle, No. 15; in beds of sand and gravel analogous to those of Menchecourt, near Abbeville; the beds are not disturbed, their average thickness is 20 feet. The implements and flint-flakes were found in a bed at the base of the gravel from 3 to 5 inches in thickness, associated with bones of *Bos primigenius*, *Elephas primigenius*, deer allied to reindeer, and a large carnivorous animal, probably cave-tiger. These observations have been confirmed by M. Lartet and Mr. Mylne. This place was signalized as a probable locality previous to M. Gosse's discovery by M. Boucher de Perthes. At Clichy, also, one implement has been found by M. Lartet.

Creil.—A flint-implement (*hachette*) has been found, under similar circumstances, in a gravel-pit at Précy, near Creil, in the Valley of the Oise (between Amiens and Paris), with a tooth of an elephant. Exhibited to the French Society of Antiquaries, 16th May, 1860, by M. Peigné Delacourt.

Rouen.—The Abbé Cochet reports two flint-implements in the museum there, which the curator, M. Pottier, states to have come from the sand-pits of Sotteville in the neighbourhood. This requires confirmation, as Mr. Evans could not find these implements in the museum, and M. Pouchet, the director, was not aware of their existence. Mr. Evans states however the pits at Sotteville to be of "precisely the character that renders it probable that flint-implements may be discovered in them."

Clermont.—In a valley leading into that of the Ariége, there is a deposit of gravel underlying brick-earth, at 510 feet above sea-level and 33 feet above the stream which now waters the valley. In this gravel, mixed with bones of *Elephas primigenius*, *Rhinoceros tichorhinus*, *Felis spelæa*, *Cervus megaceros*, *Equus*, and *Bos*, have been found manufactured "pieces of quartzite." Dr. Noulet says, "One of them is 4 inches in length, 2½ inches wide, and its greatest thickness 1 inch. It has been formed into shape by chipping it on only one of its faces. The second is much more important; both its faces have been modified to bring it to the shape it now presents. The side and point, which is truncated, present a bevelled edge; but the base, which is cut obliquely, has *evidently been polished even with care*. This is also about 4 inches long, 2¾ inches wide, and 1¼ inch thick."* Mr. Evans passes a comment on this statement. "If it be," he says,

* See also an account of a very curious discovery, somewhat of the same nature, in M. Lartet's 'Researches respecting the Co-existence of Man with the Great Fossil Mammalia,' in the Ann. des Sciences Naturelles, 4th ser., tom. xv.

"really the case that this is in part polished, and that this polish is not due to the natural fracture, it is certainly a singular fact in connection with the implements of the Drift period, which have hitherto always been *not* ground. Dr. Noulet, however, has paid some attention to this class of antiquities, as he draws a distinction, on account of their rude workmanship, between these implements and the *haches gauloises ou celtiques*.... Beside the chipped implements, round pebbles also occurred, which are considered by Dr. Noulet to have been used as hammers; and, though the account he gives of the whole discovery is not to my mind quite conclusive, it appears to be a proper case for further inquiry."

Swalecliffe (I. of Sheppey).—At the end of Stud Hill Cliffs, near the Swalecliffe Coast-guard Station, Mr. Evans picked up a flint-implement of the oval-pointed form, stained by ochreous colours, from having lain in the gravel; and in the Drift capping the highest point of the cliff, close to the farm-house at Stud Hill, a portion of tooth of *Elephas primigenius*.

Peasemarsh, Surrey.—One implement found by Mr. R. Whitbourn, F.S.A., of Godalming, twenty-five years ago, in a gravel-pit. "It was embedded in gravel, in a layer of sand about 4 or 5 feet from the surface, in apparently undisturbed ground." Mr. Whitbourne adds, "I have heard of remains of large animals having been discovered in the same beds, but not in very close proximity to the spot where it was found." The gravel-beds of this district have been examined and described by Mr. Godwin-Austen, in Quart. Journ. Geol. Soc. vol. vii. p. 278, in which communication he states that remains of *Elephas primigenius* are frequently found in this gravel, and that at Peasemarsh there are traces of an old land-surface, with branches of trees and the bones of these animals uninjured and lying together.

Horton Kirby, Kent.—An implement of the round-pointed form was found (November, 1861) on the surface of the ground at the top of the hill, on the east side of the River Darent, about a mile E.S.E. of Horton Kirby, by Mr. Whitaker, of the Geological Survey.

The remainder of this valuable paper is chiefly devoted to extended illustrations of Mr. Evans's original classification of these implements into, 1, flakes; 2, weapons with an acute or rounded point; 3, oval or almond-shaped implements, with a cutting edge all round. A plate of twenty examples, drawn to a scale of one-half linear, is given, and will be very useful to students and inquirers in conveying a correct idea of the sorts and kinds of these objects. Plates of the flint-implements from the Valley of the Ouse, Swalecliffe, and Reculvers—one of the latter formed from a large Tertiary flint-pebble—are also given.

Memoir of Geological Survey. Decade X. Preliminary Essay upon the Systematic Arrangement of the Fishes of the Devonian Epoch. By Professor Huxley.

A most valuable contribution this to palæontological science. From the endeavour to determine the systematic position of *Glyptolæmus* in first describing it in Dr. Anderson's "Dura Den," Professor Huxley has been led to the reconsideration of the classification of the fishes of the Devonian epoch, and eventually to make important modifications of the received arrangement of the Ganoidei. We give a brief summary of the Professor's views.

Glyptolæmus is regarded as a tolerably typical member of a large and well-defined family of Ganoids which abounded in the Devonian epoch, but whose members have been less and less numerous in more modern formations, until at present its sole representative is the African *Polypterus.* The genus which approaches it most closely is the *Gyroptychius* of M'Coy. *Glyptopomus* is another closely-allied genus, as is evidenced by the structure of its skull. The angles of the scales of Gyroptychius are apt to become rounded off so as to present a transition from the rhomboid to the cycloid contour. It is then the less surprising to find fishes with cycloid scales so similar in their organization to Glyptolæmus, Gyroptychius, and Glyptopomus as imperatively to demand a place near them in any natural arrangement. The description of *Holoptychius*, compared with that of Glyptolæmus, will show their essential alliance, but the scales are in form and sculpture widely different. *Platygnathus* is closely allied to Holoptychius. *Glyptolepis*, with its remarkably ornamented scales, is closely allied to Holoptychius. These six genera, then, possess characters in common, and constitute a family of Ganoids, the Glyptodipterini, and which may be subdivided into a rhombiferous group, containing *Glytolæmus, Glyptopomus*, and *Gyroptychius*, with diphycercal tails; and a cycliferous group, containing *Holoptychius, Platygnathus, and Glyptolepis.* The family of Saurodipterini, distinct from, although allied to the Glyptodipterini, comprises not only the genera *Osteolepis, Diplopterus*, and *Triplopterus* (?), but also, Professor Huxley believes, the *Megalichthys* of the Coal. The Saurodipterini and Glyptodipterini being separated from other palæozoic fishes as well-defined but closely-allied families, the author goes on to consider what others can be ranged with them, or, in other words, what are the limits and what the importance of the larger group formed by the association of these families. The Ctenododipterini, a family just established by Pander for the reception of Dipterus and its immediate allies, must, he considers, take its place in close juxtaposition to the Saurodipterini and Glyptodipterini, seeing that it possesses all those structural peculiarities which are common to those two families; but the former differ in the smoothness of their scales and other points, but chiefly in the peculiar form of the lower jaw, which much resembles that of a Cœlacanth, and in their dentition. In the next place, the true Cœlacanthini have a no less well-defined right to occupy a similar position, but the Professor restricts the group to *Cœlacanthus, Undina*, and *Macropoma.* The type species of *Cœlacanthus*, that on which the genus was founded by Agassiz, is the *C. granulatus* of the Magnesian Limestone, which in all the great features of its organization is similar to *Undina;* so that, contrariwise, any fish which differs in essentials very widely from Undina can be no Cœlacanthus. As the case stands, then, there is no evidence of the supposed distinction between *Cœlacanthus* and *Undina;* while, on the other hand, a recent comparison of well-preserved specimens of *Undina* and *Macropoma* has led to the conviction that these two genera are not much less closely allied. All the structural characters which are among the peculiarities of *Undina* are equally well marked in *Macropoma*, except that the teeth are more distinct and cylindrical. But further than this, as Dr. Mantell originally suspected and as Professor Williamson has since demonstrated, *Macropoma* exhibits the peculiarity, seemingly without a parallel among fishes of other families, of having the walls of its air-bladder ossified. Now Professor Huxley finds good evidence of the existence of a similarly ossified air-bladder, not only in *Undina*, but in a well-preserved specimen of a new genus of Cœlacanth* from the Lias, in the Museum of Practical Geology. Thus it appears to be certain that fishes closely allied to *Cœlacanthus granulatus*, forming a well-defined family, have ranged in time, with remarkably little change,

* *Holophagus Gulo*, described in this Decade by Sir P. Egerton.

from the Permian formation to the Chalk inclusive; their special affinities being chiefly with the Ctenododipterini, the scales, the arrangement of the teeth, and the form of the lower jaw presenting many curious analogies. The Glyptodipterine family contains, as we have seen, both cycliferous and rhombiferous genera; and following out the alliances of the former sub-family, the cycliferous Ctenododipterini and Cœlacanthini have been included in the same larger or sub-ordinal group with the Glyptodipterini. On the other hand, tracing out the congeners of the rhombiferous sub-families, we have arrived at the Saurodipterini; and the question then remains, what other rhombiferous Ganoids naturally arrange themselves at this end of the series? So far as the Professor is aware, there is no other fossil rhombiferous Ganoid which comes within the scope of the sum of characters common to the Saurodipterini, Glyptodipterini, Ctenododipterini, and Cœlacanthini; but among recent fossils there is one, the *Polypterus*, which very nearly approaches the required standard, and is unquestionably allied to the Saurodipterini. These results are then put in a tabular form thus:—

Order GANOIDEI.

Sub-orders—

I. Amiadæ.

II. Lepidosteidæ.

III. Crossopterygidæ.

Fam. 1. Polypterini.

Dorsal fin very long, multifid; scales rhomboidal.

Ex. *Polypterus.*

Fam. 2. Saurodipterini.

Dorsal fins two; scales rhomboidal, smooth; fins subacutely lobate.

Ex. *Diplopterus, Osteolepis, Megalichthys.*

Fam. 3. Glyptodipterini.

Dorsal fins two; scales rhomboidal or cycloidal, sculptured; pectoral fins acutely lobate; dentition dendrodont.

Sub-Family A, with rhomboidal scales.

Ex. *Glyptolæmus. Glyptopomus, Gyroptychius.*

Sub-Family B, with cycloidal scales.

Ex. *Holoptychius, Glyptolepis, Platygnathus* [*Rhizodus, Dendrodus, Cricodus, Lamnodus*].

Fam. 4. Ctenodipterini.

Dorsal fins two; scales cycloidal; pectorals and ventrals acutely lobate; dentition ctenodont.

Ex. *Dipterus* [*Ceratodus? Tristichopterus?*]

Fam. 5. Phaneropleurini.

Dorsal fin single, very long, not subdivided, supported by many interspinous bones; scales thin, cycloidal; teeth conical; ventral fins very long, acutely lobate.

Ex. *Phaneropleuron.*

Fam. 6. Cœlacanthini.

Dorsal fins two, each supported by a single interspinous bone; scales cycloidal; paired fins obtusely lobate; air-bladder ossified.

Ex. *Cœlacanthus, Undina, Macropoma.*

IV. Chondrosteidæ.

V. Acanthodidæ.

In this table it will be seen that Professor Huxley adds the suborder (III.) Crossopterygidæ (κροσσωτός πτέρυξ, "fringed fin") to those proposed by Agassiz to comprise the existing *Polypterus* and all those extinct ganoids which fall within the following definition:—

"Dorsal fins two, or, if single, multifid or very long; the pectoral, and usually the ventral, fins lobate; no branchiostegal rays, but two principal, with sometimes lateral and median jugular plates, situated between the rami of the mandible; caudal fin diphycercal or heterocercal; scales cycloid or rhomboid, smooth or sculptured."

The fifth family also has been added by the Professor for that singular genus *Phaneropleuron*, described and figured in this decade.

Of the group of Crossopterygidæ, as thus established, four families are not only palæozoic, but are some wholly and all chiefly confined to rocks of the Devonian age,—an epoch in which no fish of the sub-orders *Amiadæ* or *Lepidosteidæ* is known to make its appearance, unless *Cheirolepis* be one of the latter. Rapidly diminishing in number, the Crossopterygidæ seem to have had several representatives in the Carboniferous age; but after this period, unless *Ceratodus* be a Ctenododipterine, they are continued high in the Mesozoic age only as a thin though continuous line of Cœlacanthini, and terminate at the present day in the two or three known species of the genus *Polypterus*, which however is clearly related to the rhombiferous Crossopterygians, or to exactly that group of whose existence we have no knowledge in any Mesozoic or Tertiary formation; while the Ctenododipterini and Cœlacanthini, which differ most widely from *Polypterus*, are those which continue the line of the Crossopterygidæ from the Palæozoic to the end of the Mesozoic period. Both ends of the Crossopterygian series appear thus to be isolated from the modern representatives of the suborder: Polypterus being separated from those members of its suborder with which it has the closest zoological relations by a prodigious gulf of time, and from the fossil allies which are nearest to it in time by deficient zoological affinity. Professor Huxley offers the following diagram in illustration of his meaning:—

Palæozoic.

Ctenodipterini, Phaneropleurini, Glyptodipterini, Saurodipterini.

Cœlacanthini.

Mesozoic.

Cœlacanthini.

Tertiary.

Recent.

Polypterini.

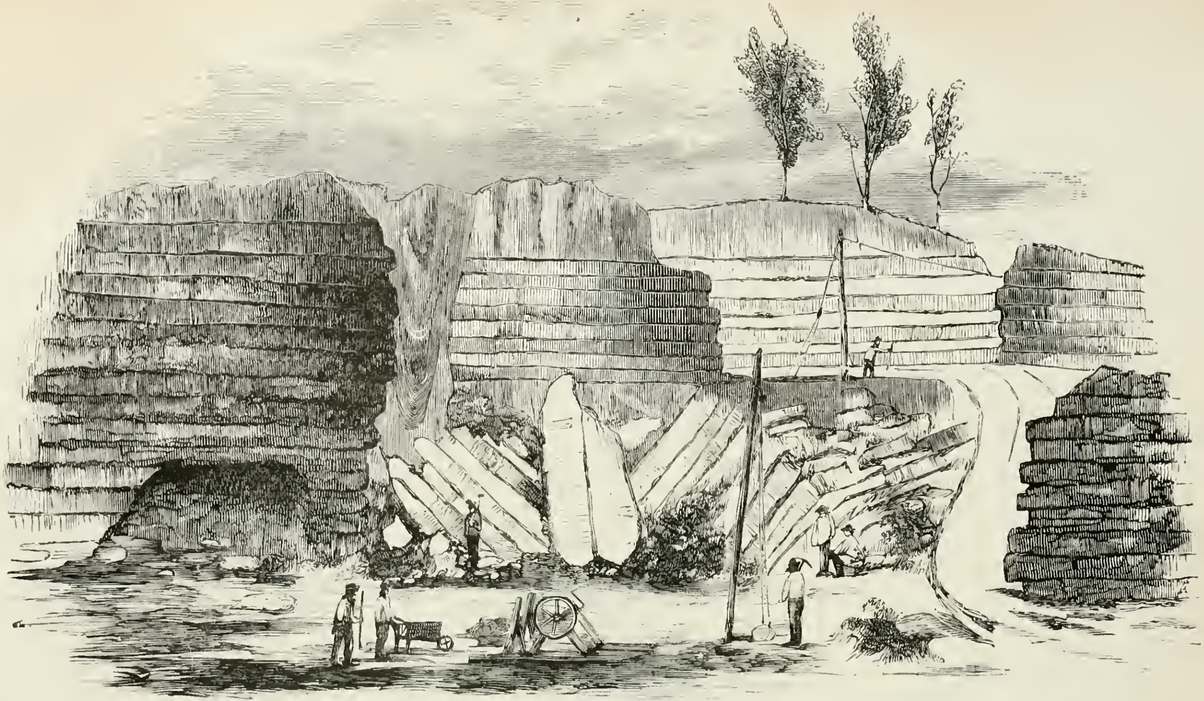
Here it is obvious, that in time the Polypterini are twice as remote from their immediate zoological allines, the Saurodipterini and Glyptodipterini, as they are from their more distant connections, the Cœlacanthini. Professor Huxley calls attention to the many and singular relations subsisting between that wonderful and apparently isolated fish, Lepidosiren, sole member of its order, and the cycloid Glyptodipterine, Ctenododipterine, Phaneropleurine, and Cœlacanth Crossopterygidæ, and he leaves the bearing of these unquestionable facts upon the great problems of zoological theory to be developed by every one for himself. The craniofacial bones which Professor Huxley recognizes in the Devonian fishes are the Supraoccipital, Frontal, Ethmoid, Epiotic, Parietal, Squamosal, Postfrontal, Prefrontal, Supratemporal, Postorbital, Suborbital, Maxilla, Premaxilla, Hyomandibular, Os quadratum, Suprascapula, Operculum, Suboperculum, Jugular, Spiracular Ossicles, and Supratemporal Ossicles.

Plates are given, executed in the first style of art by Mr. Joseph Dinkel, of *Glyptolæmus Kinnairdi*, *PhaneropleuronAndersoni*, which are described by Professor Huxley. Sir P. Egerton figures *Tristichopterus alatus*, *Acanthodes Peachii*, *Acanthodes coriaceus*, *A. Mitchelli*, *Climatius scutiger*, *Diplacanthus gracilis*, and *Cheiracanthus latus*.

The importance of this communication on the palæontological history of fishes must be manifest to all of our readers, and we hope that a Table, exhibiting the classification of Devonian fishes, showing the genera ranging throughout the different beds, and thus exhibiting at one view both the classificatory and geological aspects of the question, may be speedily given by the learned professor, whose work we have read with so much pleasure and instruction.

Revue de Géologie pour l'Année 1860. By MM. Delesse and Laugel.

We cannot better explain the object and scope of this work than by quoting a portion of the preface. The authors say :—"Every day geology extends its empire ; in all civilized countries and their colonies, even in the most remote, facts are collected with ardour which may serve to explain the history of the earth. It is characteristic of modern science, and this observation is especially applicable to the natural sciences, not to progress simply by the efforts of some few men of genius, but likewise to receive constant impulse by the co-operation of a crowd of observers, sometimes as obscure as they are devoted. . . . Without a spirit in favour of any particular system, without preconceived opinions, we shall endeavour to present every year an impartial, faithful, and concise account of the geological labours undertaken in every country. We ought to restrict ourselves within sufficiently narrow limits. If our work presents any omission, we beg that it may not be imputed to any wish of our own ; if it contains any inaccuracies, we shall feel obliged by being informed of them. We shall receive with gratitude all communications that may enable us to improve a work, of which we do not wish to conceal from ourselves either the difficulties or imperfection." The well-known industry and ability of the authors should lead us to expect that this endeavour would be carried out in a satisfactory manner, and we may say with confidence that this Review for 1860 will be of great service to the students of geology. It must however be borne in mind that the authors have chiefly devoted their attention to what has been done out of France, especially in England and Germany ; and that they do not pretend to give an account of the geological memoirs which appear in the widely circulated French publications.



IGUANODON QUARRY (KENTISH RAG-STONE) AT MAIDSTONE, KENT.

S. J. Mackie, F.G.S., del.

THE GEOLOGIST.

AUGUST 1862.

M. GRAS' ATTACK ON THE EVIDENCE OF THE FLINT-IMPLEMENTS IN RESPECT TO THE ANTIQUITY OF MAN.

It is extraordinary how many people have an obliquity in their mental vision. Some mentally never see straight at all, but look at everything askew. These are harmless people; you know them at once, and pity their defects, just as you do a person with a downright squint. But those who have a slight cast in the eye are the most dangerous; you are not aware they occasionally squint; you do not perceive, perhaps after even a close scrutiny, that there is anything amiss with their vision at all. So it is with the mental cast; you do not observe it, as a general rule, for it is only now and then it shows itself.

When the Antiquity of Man was first proclaimed from the discovery of the Abbeville flints by Boucher de Perthes, no one believed it. Everybody thought him like the mad man who swore all the world was mad; and so it seemed, then, as if all the world had mental obliquity of vision, which made them declare our *savant* of Abbeville to be labouring under a delusion. When, however, Rigollet, Prestwich, Flower, Lyell, Evans, and others of the goodly company of geologists,—as unbelieving, however, as so many St. Thomases,—went, saw, and returned believing, the fame of Boucher de Perthes' discoveries gained ground. Some there were who hardened themselves in their unbelief, and hazarded wild theories of ocean-waves chipping out artificial forms, and of recent objects sinking down in the ground, and burying themselves, and other equally untenable notions, but these waxed fewer and fewer, not by dying out, but by becoming converts to the novel truths. Others there were who enthusiastically grasped at everything that came in their way, and attempted to send back half the antiquities of the historic period to the Gravel age. These still exist, and if their labours be a little rash, they are not altogether useless. If they make a great many mistakes, they now and then drop on a new fact, and *that* covers a multitude of failures. Others there are, and these are the best of all, saving the real workers for science, who lose no chance of collecting anything they think may afford *useful* knowledge. The people, so common at one time, with the dreadful mental squint about the flint implements of the gravel age are now, as we have said, few and far between, but there are still some possessed of the dangerous slight cast of mental obliquity, if we mistake not—that is, if the obliquity does not lie with ourselves. Of course we do not think it can, nobody ever does. Our worthy contemporary the 'Parthenon,' who says, or rather prints a great many good things, has lately printed a translation, from the French 'Comptes-Rendus,' of a paper by M. Scipion Gras, who brings up a question we really had thought completely settled. We knew our best men had gone to see; we knew they had come back testifying to the facts. But now M. Gras comes forward with an article "On the Insufficiency of the Arguments drawn from the Position of the Worked Flints of St. Acheul to show the Existence of Man during the Quaternary Period." There is mental obliquity somewhere, that is certain; we fear it rests with M. Gras, for he says he went to St. Acheul, "desirous of enlightening *his doubts*" as to the conclusions drawn from the position of the flint axes there. Of course we saw the notice of M. Gras' paper in the 'Comptes-Rendus,' where it appeared a short time before our contemporary printed the translation; we think also we saw it noticed in 'Cosmos,' but we thought it best to let it alone. We saw no good in stirring up uselessly a vexed question, by a reference to a paper, the arguments in which were either founded on erroneous bases or altogether futile. As, however, our respected contemporary has brought the paper before English readers, who otherwise perhaps would never have heard at all of it, we cannot let M. Gras' opinions pass without comment. M. Gras shall, however, have fair play at our hands. We will give the translation intact before our comments. He begins:—

"There are found at St. Acheul and in its neighbourhood (leaving out of question the more elevated plateaux) two diluvial deposits which appear to be quite distinct. The more ancient one, immediately overlying the chalk, is essentially composed of light yellowish or brown flints, for the most part rolled, disseminated through a whitish-grey calcareous sand. The relative proportion of the sand and flints varies; sometimes veins of almost pure sand alternate with flints, or cover them. It is not uncommon to find in the sand freshwater shells, almost intact, in spite of their fragility,—a fact which indicates a slow process of accumulation. Ferruginous infiltrations from above have often stained the naturally clear colour of this deposit. This diluvium has a very unequal thickness, owing to the numerous erosions which it has undergone. It shows itself at St. Acheul at a height of from thirty to forty mètres above the Somme; at the sand-pits of Moutiers, at the western extremity of Amiens, it descends all at once to the bottom of the valley; finally, at Menchecourt, a suburb of Abbeville, it passes beneath the turf-beds. It results from this, that before the deposit of this transported bed, the Somme had already hollowed out its channel in the bosom of the chalk, which is seen rising right and left to a great height. The valley was even then deeper than it is now; it appears to have been entirely filled up at the time of the arrival of the rolled flints. The second diluvial bed in the neighbourhood of St. Acheul is an argillaceous-sandy stratum of a dark brown, of which the thickness is usually from a mètre and a half to three mètres; it is almost everywhere dug for brickmaking. It shows usually at its base a thinnish layer of angular flints disseminated through a brown earth, rather more sandy than the rest of the mass. This argillaceous-sandy diluvium extends crosswise at once over the lower clear grey diluvium and over the chalk; it presents all the signs of complete independence. Its deposition probably coincided with the second excavation of the valley; it is observed, in fact, at different levels corresponding with those at which the Somme has successively flowed before withdrawing itself to its present bed."

In this account there are three topics which call forth observations. 1. *There are (at least) two diluvial deposits.*—There is nothing new in this. Mr. Prestwich, one of the most inquiring and capable investigators of the subject, and one of the strongest believers in the correctness of Boucher de Perthes' assignment of the chipped flint-implements to the Gravel age, has already shown that there is a "high-level gravel" and a low-level or "valley-gravel;" and in his papers before the Royal Society has shown, also, why there are these deposits, what are their relations to each other, the probable physical and meteorological conditions under which they were deposited, and their bearings in respect to the evidence of the flint-implements as a proof of the antiquity of man. 2. *That it is not uncommon to find in the sand freshwater shells, almost intact, in spite of their fragility.*—There is nothing extraordinary in this. The wonder would be if we did *not* find them. Mr. Prestwich has shown how much ice-action had to do with the bringing down, during the early spring floods, of the flints, rock-boulders, and other heavy materials,—probably often also the bones of animals; and if these heavier substances were frozen into the ice-floes, *masses* of fine gravel, sand, and earth, enclosing fragile shells, would also be brought down in the same way. Moreover the *gravel* deposits would chiefly be formed during the period of spring floods caused by the melting of the ice; and consequently during the summer there would be a period during which mollusca might live under the influence of the quieter river actions, which actions would naturally intercalate beds and streaks of sand and clay with freshwater shells amongst the coarser gravels. 3. *That the Valley of the Somme was even then deeper than it is now; and appears to have been filled up at the time of the arrival of the rolled flints.*—All this has nothing to do with the question of man's antiquity at all; besides there is no proof given by M. Gras. What he states as to the various deposits and their conditions go for nothing in this respect; they simply do not bear upon the point at all. It matters not whether the valley was hollowed out, whether it was filled up or not, before the "rolled flints" were brought in, so long as the gravel deposit containing the flint-implements can be proved to be of *geological age*—that is the point; and M. Gras, if we *do* not misunderstand him, admits the flint-implement-bearing beds are *covered* by other diluvial or alluvial deposits—a sufficient admission of their antiquity.

As to a previous complete excavation of a valley before any deposits collected in it, such a notion in the main would be a very fallacious one, for the scouring action of water and rainfalls is as great beneath a deposit as it is over its surface. Rains wash away visibly the fine soil on the surface, but the water that filters through also washes away invisibly the fine disintegrated surface of the rock on which the deposit lies; so the whole mass of deposits gradually—slowly but surely—*sinks* into a greater and greater subterranean valley as age follows age.

But to return to M. Gras—for he himself admits the position that the flint-implement gravel *was* covered over, in the following passage:—

"By the help of these details a clear idea may be formed of the position of the worked flints; they are found in the lower grey diluvium at variable depths, and often considerably below the surface of the soil. An attentive examination of the flinty mass which encloses them yields no re-arrangement of materials. Moreover, everywhere above these flints there is a thickness of two or three mètres of diluvium of the latest date, of a brown colour. This itself appears to be perfectly intact, and sharply separated from the grey diluvium; which excludes the possibility of the introduction of foreign objects vertically through the argillaceous-sandy earth."

But here follows what certainly shows either M. Gras' obliquity of mental vision, or our own. If we err, however, fortunately we shall be in goodly company, for we shall be on the side of Prestwich, Rigollet, Lyell, Evans, and those many others who hold the like opinions with ourselves upon the subjects M. Gras attacks. Let M. Gras, however, speak his own arguments:—

"These different circumstances, in appearance so conclusive, are not however irreconcilable with the idea of diggings having been made, at a certain epoch, in the soil. Before demonstrating this, I must dwell upon some important facts. The first is, the integrity and perfect preservation of the axes; they look as if just come from the hands of the workman. It has been inferred (the inference was unavoidable) that they were buried on the spot, or brought from very near localities. A second fact, not less remarkable, is the truly astonishing multitude of these axes. The number of them found at St. Acheul, in the compass of about a hectare (two acres), has been estimated at more than three thousand. The rich collection of M. Boucher de Perthes alone contains more than a thousand. M. Albert Gaudry, who has caused diggings to be made, has seen nine of them disinterred, one after another, in close succession. The fact of the multitude of worked flints, joined to the entireness of their edges, shows clearly that there was formerly a considerable manufacture of these objects on the spot. If we adopt the hypothesis of those who would place this manufacture beyond historic times, it must needs be admitted that there existed on the banks of the ancient valley of the Somme a people of the quaternary epoch occupied in cutting axes by thousands. As evidently it could not use them all, it must doubtless have supplied them to other quaternary races of the neighbouring countries. But if this were so, why has this industrial population of the ancient world left no other trace of its existence except these rudely-fashioned flints? Why, above all, do we not find human remains in the diluvium? Their absence is the more astonishing, as it is not uncommon to find there the remains of elephants, rhinoceroses, and other animals. If men, so civilized as to occupy themselves with commerce, lived on the banks of the Somme at the commencement of the quaternary period, they must have constructed habitations there, and these would be seen now in the mass of diluvium which at a later period filled up the valley; they would even be perfectly preserved in it. Now this deposit has never presented the least vestige of a habitation, nor even of other products of human industry, excepting flint objects. Another consideration strengthens all these grounds of doubt; worked flints, similar to those which are claimed as diluvian, have been found in such a position, that it has been necessary to attribute to them a modern origin. M. Toillez, an archæologist and engineer of Mons, possesses a collection of four hundred axes, which for the most part are rough, and do not differ sensibly from those of St. Acheul; nevertheless, they have all been collected at the surface of the soil. Is it admissible to suppose that products so similar were manufactured, the one set at the commencement of the quaternary period, the other during the now existing period, seeing that an immense interval of time separates the two epochs?"

Here again we select the points of attack:—1. *The perfect preservation of the axes.*—"They look as if they had just come from the hands of the workmen." Say "*some* look," and then we shall reply, Quite right, M. Gras; some do look as if they had just come from the hands of the workmen. Assuredly they do—and very naturally too, seeing they have in reality just come from the hands of the workmen. We have seen abundance of forgeries, both from the valley of the Somme and from Yorkshire. There are indeed plenty of forgeries. Nevertheless there are some *real*; these however are comparatively few. No one ought to mistake the real geological flint-implements from the forgeries. No one who is used to break flints but ought to tell readily whether a flint was broken with an *iron* instrument or not. A modern hammer will not crack or flake a flint in the same way that a stone will. Try it, reader, and see for yourself.

Setting aside forgeries, there is even then no reason why the flint-implements should not be in good preservation. If first frozen into a mass of ice, then transported enveloped in, and protected by that ice-casing, then dropped on the floor of the wide-spread river-flood by the melting of the ice, then covered over perchance by the soft materials of the summer stream, or left on the verdant marshy tract during the interval between the periodical floods, what was there to weather or otherwise injure so hard a substance as flint? Nothing that we know of. Moreover, the truth is, that as far as our experience goes—and we have seen more than a few of the fossil flint-implements—they are by no means all always so wonderfully perfect. Some are decidedly worn—even as much so as the gravel in which they are found.

2. *The astonishing multitude of these axes.*—Surely, no one thinks *one* man made the lot, or that they were all made at once. Geologists always cry out for "plenty of time." They ask for plenty of time—a whole geological age—for the formation of the gravel deposits. So therefore the primitive men had a *whole age* to chip flints in. The very quantity of elephant and other bones found in the gravel-beds shows nature did take an age to form them, unless we suppose a supernatural increase and growth of living beasts, followed by an equally supernatural and wholesale destruction. But in reality, *how* common are the true worked flints? We have seen *one* only from all the great gravel-beds round and under London, and miles of them have lately been cut through for the sewer-works. We have seen, may be, half a dozen from Suffolk, a like number from Bedford, two or three from Kent, and less than a dozen more from all parts of England. As to the Yorkshire specimens, we must know more about them, and *where* they

come from, before we can say much about them. I suppose, however, whether ancient or modern, not more than a hundred exist from that, the largest county in England and numbering as many acres as there are words in the Bible. M. Gras says, however, that in the rich collection of M. Boucher de Perthes, there are more than a thousand; that M. Toillez, of Mons, possesses four hundred; and that at St. Acheul the number *found* in the compass of a hectare (two acres) has been estimated at more than 3000! Now, does M. Gras mean that at St. Acheul two acres of gravel have been excavated for flint-implements? or does he mean that in proportion to the quantity of gravel actually excavated there, an estimate has been made of the probable number of 3000 as existing in two acres of gravel? How many feet thick? There's a rub. Two acres, 30 feet thick, would contain some millions of tons of gravel, this proportion of flint-implements to the number and quantity of unworked flints and pebbles in which would be very small indeed. Take the total of 3000 in another way, and suppose each man of a tribe numbering a hundred males to make or lose one new weapon every two years, from the age of twenty to the age of forty, after which period of lifetime we will suppose every man to be either useless, superannuated, or killed in battle or by wild beasts in the chase. Then it would only take three generations of this little tribe to make or lose the quantity M. Gras thinks so enormous.

Really there is nothing wonderful in this total after all. When we come to look into it, we only wonder it is not more.

3. *That the worked flints were manufactured on the spot.*—Many might have been; certainly not *all*. We have already disposed of the assertion of the universal preservation of their perfect sharp edges. The sharp edge of a newly-broken flint will cut your fingers—try it; we have never seen the edges of a flint axe or even a fossil flint flake that would.

Some, we have said, were probably ice-borne down the annual floods. If Mr. Prestwich be right in his supposition of their being ice-chisels, in some localities where the primitive men had fishing-stations many might be dropped through the holes they were used in breaking out. As to the commercial aspect which M. Gras suggests, it would neither make for nor militate against the antiquity of man. We are sorry to say, however, that we have not so high an opinion of the intellectual capacities of these our primitive ancestors —if *our* ancestors they really were, and perhaps they were not—as to believe them capable of commercial enterprises at all. Moreover, the traffic in flint weapons presupposes the means of international communication; we doubt very much if the flint-implement men, who could do no more than *chip* stones,—who did not know even how to grind them,—had any means for this. The Veddahs of one tribe at this hour do not know the Veddahs of another tribe, their next neighbours; less than fifty miles of mere territory part them. For our own part, we think so poorly of the flint-implement men as to be scarcely inclined to feel any more pride in a pedigree from them than from the much-abused and hirsute Gorilla.

4. *Why has this industrial population of the ancient world left no other trace of its existence? Why, above all, do we not find human remains?*—How many skeletons of all the known species of fossil monkeys all over the globe have been exhumed from their stony tombs? Are there a hundred fragments in all the collections of all the museums and naturalists in every region and part of the earth? And have we found every kind of fossil monkey yet? No sane man will assert it. Human teeth have been found in Pleistocene strata as old as the gravel-beds; negative evidence we have seen too often to mean nothing, to trust it in a question like this. Human remains *have* been found with bones of the mammoth, and fossil deer and bear, although these are ignored. Those as yet found we admit *may* not be the remains of the flint-implement-making men. "Wait patiently, they will yet be found." But will M. Gras declare that there are not in the gravel-beds of the Somme seams of brittle lignite; and will he venture to assert that these may not be the charred remains of huts?

Take another view. The beast, when he sickens to die, goes to some retired spot and leaves his inanimate carcass on the soil. There it may become embedded, or the floods may lift and strand it on some shallow bank. Nature buries it or moulders it, and returns it dust to dust in her own way. When a man dies, the case is different. The cow weeps not for the death of the bull, the lion sheds no tears for the loss of the lioness, the hippopotamus scrapes no hole in the earth to bury its lifeless mate, the gorilla lights no fire to burn to ashes the mother of its progeny. The *lowest* of human beings must have had *human passions* and *human feelings*. The primitive wife, little sensible as we can but conceive of anything like fine sensations, would, degraded as ever we could possibly conceive her, naturally weep for the loss of her husband; and though no priest performed a marriage ceremony, in such relationship notwithstanding ever stood the union of *human* beings. The man would mourn for the loss of his helpmate. Death to human beings would always have had a different aspect to what death has to the beast. In the human heart there would be the innate desire to lay the lifeless corpse or its ashes *where* its resting-place could be visited. If the flint-implement men were *human*, such must have been, even in the first of this pristine race, the feelings which death would evoke; and if such the feelings, *burials* or *burnings* must have disposed of the mass of that primitive race. If burials, we must look elsewhere than to the débris of floods or the alluvia of river-beds for human bones.

We may search for a later but still early race near where the great monoliths and the gigantic stones of so-called Druids' temples exhibit their weather-beaten forms; but if cremation were practised, then for all traces of the flint-implement makers, other than their works, we must trust to chance alone.

The massive bones of the great beasts could not escape the eye; the teeth and skulls of smaller animals would at once attract attention; but what notice would a few fragments of calcined bones amongst the débris and broken fragments obtain?

What explorer of caves, what digger in gravel-pits, has searched over the heaps of bone-bits always thrown aside as waste? In this respect we have followed the common way; but we are not without suspicion that more than once we have missed our chance.

5. *That worked flints, similar to those claimed as diluvial, have been found in such a position that it has been necessary to attribute to them a modern origin.*—No instances are stated by M. Gras; we cannot, therefore, refute any cases to which he alludes by statements of the facts. Besides which, if such specimens exist under such circumstances, they may be forgeries; or they may be relics—and this is not at all unlikely—preserved by more modern tribes. We know that the savage races of the present day do sometimes treasure the weapons of their ancestors; and there are many other ways in which such occurrences may be explained when the actual circumstances are given.

6. *That M. Toillez' axes have been collected at the surface of the soil.*—This is put as a "poser" by M. Gras; but strong as he thinks it, it goes down at once before a simple question. It is slaughtered by a breath. Do we not find ordinary *gravel*-flints in myriads on the surface of the soil? Can you go through any field,

over any downs, across any chalk country, and not pick up, if you please, tons upon tons or cart-load upon cart-load? If one sort, why not the other? Is the proportion of flint-implements to unworked stones likely to be less in the disintegrated gravel-bed strewn over the soil than in the solid untouched stratum lying intact in the earth? And if not, are we less likely to find flint-implements on the surface of the soil than in the gravel-beds beneath it? We are sure we need not reply to these questions—our readers will have answered for themselves.

7. *Is it admissible to suppose that products so similar were manufactured, the one set at the commencement of the quaternary period, the other during the now existing period, seeing that an immense interval of time separates the two epochs?*—Supposing the facts to be true,—but the facts are not stated by M. Gras, as already observed,—it might be so, if it be admissible to believe that small tribes or scattered individuals of a nation or race of mankind *could live on* after the *destruction* or *distribution* of the great bulk or mass of the nation or race. Just as some modern uncivilized tribes are presumed to be the descendants of once numerous and powerful peoples. Just as British and Celtic articles may be met with in Saxon and Roman graves; just as medieval relics are still treasured in our houses, so may we always expect to find some relics of more ancient races amongst the relics of the more modern ones. The case put however by M. Gras is a presumption, and it is futile to fill our pages with suppositions in reply to suppositions. We go on therefore to M. Gras' final summary:—

"To all these difficulties one single fact only can be opposed, that, namely, of the absence of all apparent disturbance in the diluvium; but this fact is not a peremptory reason, for it may be explained in a plausible manner.

"Let us refer the manufacture of axes, which everything proves to have formerly been carried on in the valley of the Somme, to the origin of historic times. It is certain that the men occupied in this employment were not obliged to go very far to procure the first material that was necessary for them. By digging in the soil to a moderate depth, they found a great choice of flints ready to be cut. This was probably even the reason why this kind of industry sprang up in the country. The digging of flints might take place in two ways, by pits or by galleries. The first means was the most costly, since it was necessary to pass through the brown argillaceous-sandy diluvium before arriving at the flints, and because the removal of the rubbish must take place vertically. The digging by horizontal galleries opened on the side of the valley, taking advantage of the steep banks, was evidently preferable. The excavation of these ancient galleries is so far from being unlikely, that even at the present day such are still made for the extraction of gravel. I have seen one at St. Acheul, and I measured its dimensions approximately: it was six mètres in length by one mètre ninety centimètres in height, and two mètres in breadth. This gallery supported itself well without props. It may be admitted that in former times the excavations were less in breadth and height, which would render them yet more solid.

"The flints freshly extracted, and not deprived of their quarry-moisture, are much easier to work than those of which the drying has proceeded to some length. It is probable, consequently, that the ancient miners roughly formed in the interior of the galleries the axes destined to be polished. After this first labour a selection was doubtless made; the least shapely pieces, considered improper for sale, were rejected and left on the spot. When, after a length of time, the galleries, which had served at once as shops for mining and for rough-hewing, had crumbled down, the chipped flints left on the floor were enveloped on all sides by the soil from whence they had been extracted. Supposing that the subsidence of the galleries was propagated up to the surface, the upper sand of argillaceous diluvium must have sunk a little, parallel to itself, without becoming mixed in any way with the grey flinty diluvium. If this was the real course of events, it is certain that at the end of some time all trace of disturbance must have been completely effaced. This explanation agrees well with the rude form of the flints disinterred—so rude, that it is difficult to understand how they can have been put to use in this state. It is confirmed by another peculiar circumstance, which had been held to be unimportant, but which, nevertheless, has much import. M. Albert Gaudry, who has been cited above, remarked that the nine worked flints discovered in his presence lay nearly all palpably at the same level. Was not this level that of the floor of an ancient gallery?"

This is how M. Gras looks at the question from his own point of view, after, as he presumes, he has demolished his adversaries. After De Perthes, Prestwich, Lyell, Evans, we, of the oblique vision in M. Gras' opinion, have been out-argued and convicted of erroneous interpretations of the facts. Well! so, for the nonce, let us suppose the case. Is M. Gras, then, right in the views he promulgates in this summary? Assuredly not. If we are wrong, according to him, on one side of the barrier of facts, he is wrong on the other. If *our* geological interpretations do not agree with the evidence of facts, *his* historical speculations certainly do not.

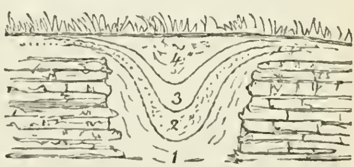
Whatever eyes M. Boucher de Perthes has for looking at gravel-beds,—and being the first to pick out the flint-implements would cause us to give him credit for sharp ones,—we can for a certainty speak of the capabilities of Mr. Prestwich's organs. We have been over very many miles of gravel and drift deposits with him, over country every lane and turning in which has been familiar to us from infancy; and we do know, from experience, that if there be anything to be seen, he will see it. For more than twenty years of his life he has been incessantly studying over England and France, as a favourite speciality, these very quaternary beds; and if any man's knowledge or judgment is to be relied upon for an opinion as to the age or nature of such deposits, assuredly it is his. Cautious in the extreme in adventuring conclusions, and fastidiously painstaking in collecting facts and testing the accuracy of his observations, no cooler intellect could discuss and put in intelligible order such intricate conditions as the gravel-beds to the inexperienced present. Those who have read his late masterly communications to the Royal Society will need no comments of ours to satisfy them of the accuracy of the views expressed, and of the ability of their author. But, to reply to M. Gras' suppositions. Referring the flint-implements to *historic* times for their origin, M. Gras states :—1. *That the makers were not obliged to go very far for their material.*—True, they were not obliged, *if*—and the whole summary involves a constant use of the little conjunction —*if* they *did make* the implements *on* the gravel-banks in which they have been embedded. This is by no means certain; but one thing is quite sure, we have ourselves *seen*—and handled—a veritable flint-implement from the valley of the Somme, which, although found in the gravel-bed, was undoubtedly and unmistakably,—we were born in a chalk district, and on the sea-coast, so we know well what flints and pebbles are,—made out of a flint nodule taken *directly* out of the chalk rock.

In this case, therefore, the primitive manufacturer went at least to the side of the valley to get material which, according to M. Gras, he had, and quite as good, on the gravel-bank under his feet. If the manufacturer could be supposed to have worn breeches, he might be supposed to have pocketed a fine nodule which he chanced to fall in with on a pleasure-ramble; but as he cannot be presumed to have so clothed his lower extremities, that presumption is untenable.

As a rule, we fancy that very many of the implements were made of flints directly taken from the Chalk; such flints would be preferable, generally, to gravel-flints, although suitable specimens could undoubtedly be collected from the gravel-beds, but not so abundantly as M. Gras infers. That some implements were made of large quaternary flint pebbles, the specimens from Herne Bay are indubitable evidence.

2. *The digging of the flints by means of pits or galleries.*—Setting aside the improbability of men digging for what they could find without labour on the surface, *what*, in the name of all mysteries, had those poor primitive savages to *dig with?* Flint-implements? It

strikes us forcibly that, with one of those poor pointed tools, a man would soon be tired of the attempt to dig a hole in gravel, much less a gallery. Half a dozen strong men—and this supposes the ancient manufacturer to have kept a staff of workmen, unless he got voluntary help from his tribe—would make but sorry progress with those pointed flints. Even our stalwart navvies would strike from such work with such tools. But *if*—we must use the little conjunction again—*if* the pits and tunnels *were* dug, were actually made, it is not true to suppose we should have no evidence of their former existence. The gravel would not sink into the excavations and show no difference of structure at those spots which had been hollowed out of the beds; for even such unsorted and heterogeneous deposits as gravel-beds are, they do distinctly show traces of former disturbances. We have clearly traced, by their appearances, disturbances made in gravel-beds by the Romans and Saxons in forming their graves or in digging for foundations of walls or pits; and what is likely to be distinctly apparent after the lapse of a thousand or more years, may be presumed to be at least detectable after the lapse of far longer ages. Moreover, *if* this explanation of M. Gras be acceded to, it involves the corresponding necessity of our finding the flint-implements in heaps or in narrow lines,—where the pits and galleries have been,—and *not* disseminated here and there, as they are, at least most usually, if not invariably. Supposing, as M. Gras does, that the subsidence into the galleries extended to the roof, there would be a furrow left at the surface, in which more recent deposits would accumulate, and if there were any sub-superficial coating of brick-earth under the soil, that would bulge downwards in concentric, curved laminæ, such as we constantly see exposed in stone-quarries when surface-clays have sunk down into fissures, and as we constantly observe in the sand and gravel pipes of the Chalk districts, in which too we often find patches of older Tertiary clays, containing shells that have been embedded in the overlying quaternary drifts.



Section in Ragstone beds at Maidstone: 1. Brick earth; 2. Yellowsand; 3. Fullers' earth, rolled; 4. Sand and gravel, filling up a fissure in 5. Kentish rag strata.

The accompanying little cut of an exposure of one of these subsidences in Mr. Bensted's quarry, at Maidstone, will show at once how visibly they leave their traces.

7. *The rudeness of the implements suggestive of rough hewing for*

an after-finishing for sale.—Rude as they are, and this is one of the points we dwell upon in proof of their antiquity, they were used in the state in which we find them, for otherwise we should find the *finished* examples elsewhere, which as yet, at any rate, we have done nowhere. We find stone and flint celts, polished and ground; but those, as we long enough ago observed in this journal, were used by the broad flat end. The large fossil flint-implements were all worked to a point, and which point, contrary to anything we know of the use of any other stone tool, ancient or modern, was the part used. There is thus, besides the absence of chipping, one positive character at least which separates the fossil implements entirely from any other effort of savage industry. Will M. Gras assert he has ever seen a pointed weapon either ground or polished?

M. Gras further lays great stress on M. Gaudry having found nine worked flints on the same level. We might speak of levels in regularly stratified deposits, what *levels* are there in a gravel-bed?

Taking it for granted, however, nine were found on one level, is that number so large as to cause surprise? *If*—why may we not indulge in conjunctions?—if there were a fishing-station on the spot, would nine be a large number to be presumed to be lost during the sojourn of the fishermen there? Or is there not an infinity of incidents which might bring together so trifling a lot?

Finally, to close our comments, may we not justly ask M. Gras if the flint implements belong to historic times? *Who* were the men that used them?*

NOTES ON THE GEOLOGY OF MAIDSTONE.

By W. H. Bensted, Esq.

The outcroppings of the Cretaceous strata in the valley of the Medway, the great quarries in the lower beds of the greensand for the much-used Kentish ragstone, the extensive chalk-pits at Burham and other places, the pottery clay-pits and the numerous brickfields, afford excellent facilities for the observation of the geological structure of Maidstone and the surrounding country.

By taking the road from Rochester, through Maidstone, to Linton, the outcrops of the Chalk and its subordinate beds are passed over in succession across their line of strike.

* The letters from Mr. Peacock, Mr. Evans, and Mr. Blake, in last week's 'Parthenon,' which has been published since our remarks were in type, show that we have by no means exhausted, even in our extended article, the refutations which can be given to M. Gras' opinions.

The chalk hills are covered, at various places, with a red, tenacious (Post-Tertiary or Diluvial) clay, in which great quantities of flint nodules are buried.

At the "Upper Bell," on the Rochester road, the chalk hill is 620 feet above sea-level, and from this altitude the spectator's view ranges over a great extent of beautiful country. In the left bank, a large tabular bed of flint, about two inches thick, crops out. Layers of hard chalk also occur here, containing numerous sharp casts of fossils—Trochi, Dentalia, Hamites, Scaphites, small Ammonites, etc. This bed is also met with at Boxley and Deptford. It is known to but few collectors, and some perseverance in breaking up pieces of this hard chalk is necessary to obtain specimens of its fossils.*

In a field at Boxley Hill, I found an Echinus in a lump of the chalk which had been strewed over the land, in the interior of which were minute shells, apparently of a species of *Arca* (?), that had probably gained access to the empty dead shell, as the Echinidæ do not swallow entire shells, but gnaw dead fishes and such-like objects with their teeth. The Spatangidæ live by swallowing sand and mud, deriving their nutriment from the organic particles they contain. Near here the Lower Chalk makes its appearance, and the great Burham pits, from which Mr. Toulmin Smith obtained many of his beautiful specimens of Ventriculites, are about a mile off, in a westerly direction. These pits are famous for the very numerous fossils of high interest which they have produced. At Halling, too, on the opposite side of the Medway, considerable quantities of chalk are dug for burning; the lime made from the chalk of these places being considered of very superior quality. It is known commercial lyas "greystone lime."

In 1839 I discovered the femur of a turtle in a pit at Halling, and also an abdominal plate at Burham. These were the first remains of turtles discovered in the Kentish chalk. But a few years later I had the good fortune to find a most perfect specimen. This unique fossil I presented to Dr. Mantell, and it is now in the British Museum.

It was figured and described by him in the 'Philosophical Transactions,' pl. 2, for 1841, and sub-

Fig. 1.—Section from Blue Bell Hill to Crowborough.

a. Tertiary Red Clay; *b b*, Drift Clay; 1. Upper Chalk, with flints; 2. Lower Chalk; 3. Firestone, or Upper Greensand; 4. Gault; 5. Redsand; 6. Kentish Ragstone; 7. Atherford Clay; 8. Weald Clay; 9. Hastings Sand.

* This seems to be the bed of "chalk-rock" referred to by Mr. Whitaker in the Quart. Journ. Geol. Soc. vol. xvii. p. 170. —Ed. Geol.

sequently by Professor Owen, in the volume of the Palæontographical Society's publications for 1851.

The chalk was dissected away, so as to admit of the removal of a great portion of the dorsal shell, and thus some of the vertebræ, four plates of the plastron, and a coracoid bone were brought to view.

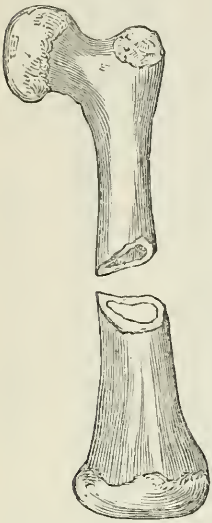


Fig. 2.—Femur of Trionyx from Halling Chalk Pit.

Since the discovery of the *Chelonia Benstedii*, Mrs. Smith, of Tunbridge Wells, has procured from the same pit a series of marginal and sternal plates of a turtle of very large size. These specimens have been admirably cleared from the chalk, and now form a part of her most interesting and valuable collection.

In 1847, another fossil turtle was found in an adjoining pit in the Lower Chalk. It corresponded in size and number of plates with, indeed it was almost a facsimile of, the original *Chelonia Benstedii.*

Perhaps the most interesting fossils found in this locality, were some long, slender, cylindrical bones, which Professor Owen considered, in the first instance (1840), if they were the remains of a bird at all, as being more allied to the Albatross than to any other. The bones there noticed are the portion of a humerus nine inches long, with one extremity nearly entire, but the other broken completely off. The uncertainty expressed by Professor Owen was afterwards cleared up by the discovery, by Dr. Bowerbank, of the head and teeth of a new species of Pterodactyle, described by him in the Geological Society's Journal, 1845, when he assigned these bones, from their microscopic structure, to that extraordinary class of flying reptiles.

The fine specimen of *Dolichosaurus*, described in the Palæontological Society's Volume for 1851, was discovered here by Mrs. Smith, of Tunbridge Wells, in 1830. A similar fossil (probably part even of the same specimen) was obtained from this same locality by Sir Philip Egerton, in 1840, and was briefly described by Professor Owen as the remains of a lizard, consisting of a series of small vertebræ in their natural position. The vertebræ are united by ball-and-socket joints, and they are proved to belong to the Saurian class of reptiles by the presence of many long slender ribs, and by the conversion of two vertebræ into a sacrum. Portions of an ischium and a pubes are connected with the left side of the sacrum, and demonstrate that the reptile had hinder extremities. These typical parts are referred to particularly, as the specimen otherwise has certainly more the appearance of a serpent than a lizard. Serpents have long, slender ribs, and therefore the saurian character depends alone on the assumed sacrum, as the extremities are wanting.

In December, 1842, Professor Owen described a fossil paddle which was exhibited at the Geological Society's meeting, as that of a marine saurian, the phalangial digits not being articulated by convex and concave surfaces, as in the terrestrial group, but by plane faces. These were roughened, indicating ligamentous connection.

Professor Owen then mentioned also the occurrence of vertebræ of a large Plesiosaurus in this chalk; the late Mr. Dixon, of Worthing, having had three or four in juxtaposition, which are now in the British Museum. He considered the specimen belonging to Mrs. Smith, of Tunbridge Wells, as probably referable to that genus. It also presented considerable resemblance to another extinct genus, the *Pliosaurus*, but the bones were thicker and not so expanded at their extremities. There was also another large saurian of the Cretaceous epoch, the *Mosasaurus;* but although fine remains of its teeth and jaws had been discovered many years ago, no extremities had ever been found. If the teeth of the Mosasaurus should be found in the locality where Mrs. Smith's specimen was got, he thought it might indicate that the paddle above referred to belonged to that genus.

The Firestone is very little developed in this neighbourhood. The only traces I have seen are thin beds, a few inches only in thickness, at Snodland, near the church. Between there and Burham Church, a bar of rock runs across the river; it is never dry, and its obstruction causes a considerable fall when the tide is low.

The best section of the Gault is at a place called the Varnes, on the banks of the Medway, near New Hythe. At low-water the lowest beds are to be seen. The bank is about fifty feet above low-water. Slips are frequently occurring from the effects of the weather, and the current of the river washing away the softer parts, when fossils may be found in abundance. Thence the gault may be traced to Folkestone on the one side, and into Sussex on the other, forming a valley at the foot of the chalk-downs. Its usual colour is light blue when dry, but of a very dark blue when wet. Some veins of red ochreous clay marked with Fuci (*F. Targonii*) occur frequently.

The gault forms a stiff soil, locally known as "black land," and its outcrop generally appears as a marshy tract. From its tenacity and its dipping under the chalk-strata, through the cracks and fissures of which the water finds its way, it forms a subterranean reservoir from the junction or lip of which the springs burst out.

I would here say a few words on the spring-heads of the Maidstone, district. These are nearly all situated in circular cavities in the Lower Chalk, where it projects over the Gault, and an interesting phenomenon is observable in the retrogression of the spring-head into the chalk by its erosive action. If we suppose the waters originally burst out at the foot of the hill B, fragments of chalk would be carried away at that point, and as the sides grew higher the rim of

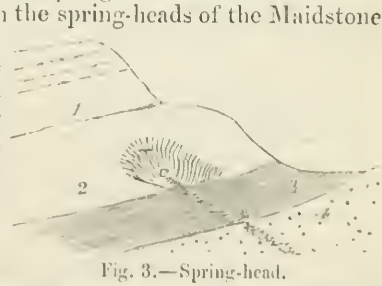


Fig. 3.—Spring-head.

the hole would expand upon the surface, and thus a rounded cavity would be formed, at the bottom of which the spring is now seen to issue (at A).

The water of these chalk springs is highly charged with calcareous matter, obtained in flowing through the chalk fissures, and this is precipitated on the fragments of sticks, roots, and leaves, which fall into the streams. At Boxley Abbey very fine specimens of calcareous tufa may be procured, as may be also incrustations of fir-cones, etc., by placing them in the water near the spring-head.

A spring of water at Cosington, bursting from the Lower Chalk, deposits a coating upon the stones in its course of a bright crimson, which at one time was considered to proceed from an impregnation of iron-pyrites, but has now been determined to be of vegetable origin.

The fossils of the Gault most common are Ammonites, Hamites, and Inocerami. At the Varnes great quantities of round nodular masses are found. On breaking these stones a nucleus with concentric waving lines is seen; they take a polish without difficulty. These nodules, so rich in phosphate of lime, have been conjectured to be coprolitic, but my opinion has long been that they are originally of zoophytic or spongeous origin, and that the presence of the phosphate is attributable to deposition from the water of the Cretaceous sea, as portions of ammonites and inocerami are found to contain equally considerable quantities of phosphate.

We now come to the Lower Greensand.—The White or Bearsted sand lies immediately under the Gault, upon the red ferruginous sands. It is limited in extent, occurring only at certain places and in different states of purity, White Heath, near Hollingbourne, affording a very superior kind. I never heard of any fossils being found in it.

The next deposit is the ferruginous sand, with layers of ironstone.

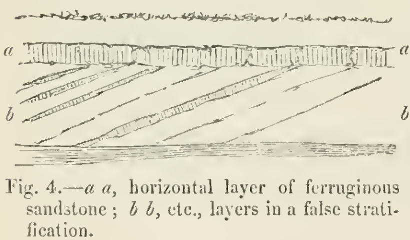


Fig. 4.—*a a*, horizontal layer of ferruginous sandstone; *b b*, etc., layers in a false stratification.

These beds rise rather abruptly from beneath the Gault at Boxley and Sandling, at an angle or dip of 20 degrees. Sections of these beds may be seen at the sides of most roads which lead to the Gault, where the sand has been cut through in many places. The most common fossils in these beds are casts of zoophytes or sponges, generally of a cylindrical shape. Some appear allied to Siphonia, having a bulbous head, the sand being loose or non-segregated in the interior. A few marine shells may be detected by close inspection, chiefly Terebratulæ. *Trigonia alæformis* occurs in a bank of this sand near Thornhills. In Sandling Wood about twenty feet of the sand is exposed, in which the ramification of a marine plant is seen to great advantage. In places rings of ironstone, circular and oblong, give an appearance of wavy lines, but by a little examination it may be seen that these lines are sections of bundles of tubes growing together; this is proved at another part by the exposure of longitudinal portions of the tubes running together nearly horizontally for a distance of four or five feet. By a turn of the bank the ends may be seen, presenting the connections of each pipe at the side.

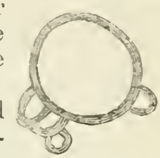


Fig. 5.—Transverse section of ironstone pipes.

In some situations at Bearsted a fine clean white and nearly pure silicious sand is found, occupying a division of the red sand adjoining the gault. The white beds are sometimes not seen near the surface, but appear to be below the red sand. Veins of red sand cross the beds of white sand in various ways.

The great development of the Kentish ragstone in the Maidstone district is a most important feature. It is found at various depths from the surface, and in detached beds of different magnitudes; the first in descending order rising from under the red ferruginous sands just mentioned. The beds then become broken and separated by valleys and faults; the latter filled up with gravel, red sand, rolled masses of yellow "fullers' earth," and red clay (brick-earth). The masses of stone extend across to the escarpment of the lower beds above the valley of the Wealden—a distance from Sandling to Linton of about five miles.

The ragstone at Barming Heath Hill has a thickness of eighty feet, and the whole series is passed through by a well sunk near the Lunatic Asylum.

The valley of the Medway is bounded on each side by this ragstone from Mill Hall to within a mile of Yalding, where the escarpment is separated by the opening in which the drainage-waters of the Weald flow out. Besides this great valley, which runs transversely to the escarpment, there are two others which separate it laterally, each giving rise to springs which fall into the Medway. A third vale or gorge has its course between the Loose Vale and the Medway. It runs from near the edge of the escarpment over the Wealden beds at Coxheath, in nearly a direct line to Tovil. This crack has very steep sides, and the ragstone is close to the surface. No water however flows in this channel, and it has all the characters of a chalk-wold. Its course is nearly parallel to the Medway.

The first of these lateral valleys begins in a meadow near Langley Heath, where a slight and gradual depression of the surface indicates the beginning of a great crack or fissure at right angles to the Medway valley. This gradually deepens until near Langley Church, where a small spring breaks out and runs on close to Boughton quarries, before reaching which however a fissure receives the water, and the stream is lost to view for some distance; but, as several issues of water flow out below in the same valley, there is little doubt that they come from the original source. Continuing onwards, they run into the Medway at Tovil. The fall is very considerable, as in the distance of two and a half miles ten mills are supplied with power.*

* This is a very valuable hint for roughly obtaining the level of a district.—Ed. Geol.

The course of the second valley is nearly parallel with the first; the spring-head is a short distance from Chislet Park. Several smaller streams, having their origin in the Lower Chalk, fall into this valley after running over the gault and passing through channels formed by divisions or cracks in the ragstone beds. At Maidstone the stream mingles with the Medway.

These two cracks or valleys in the ragstone are situated on the east side of the Medway; the west has no such breakage of the strata into vales, but by its compactness turns the course of the river from south-east to north-west, which latter direction it takes on passing the town of Maidstone.

The land is of considerable elevation on the west bank of the river, and the ragstone is found in larger beds; in some situations very near the surface.

As a general rule it may be laid down that, in this district, the faults run parallel with the larger crack or valley, as is the case in all the quarries in the vicinity of Maidstone. The dipping of the strata is not always greatest according to the proximity to the line of disturbance; and but little variation is found from the horizontal position in the higher and more compact beds, although the abundance of vertical cracks and fissures testify to the great disturbances they have been subjected to at different periods of time.

The Kentish Ragstone series consists of limestones, with alternating beds of soft sandstone, called "Hassock" by the workmen. In some parts beds of dark flint or chert are substituted for the limestone. The average thickness of the layers is about 12 inches, and the stone is of various degrees of hardness and compactness, the lowest being the most fossiliferous, and having moreover characteristic distinctions from the upper in colour, texture, and fossil remains. In some layers the distinctions are difficult of detection, but these observations apply to the ragstone within five miles of Maidstone, and as far only as my own experience goes.

The analysis made for Professor Phillips's "Observations on the Kentish Ragstone" gives the following proportions:—

Carbonate of Lime, with a little Magnesia......	92·6
Earthy matter	6·5
Oxide of Iron	·5
Carbonaceous matter	·4
	100·0

It may be interesting here to describe my own quarry in these much valued stone-beds, and which is known now as the "Iguanodon Quarry," from the discovery in it of the gigantic remains of that enormous reptile. It is the largest in Kent, and produces stone of very excellent quality. The number of layers of building- and road-stone is 21, alternating with beds of hassock, and the vertical depth worked is 75 feet. The strata here have no dip, although they are traversed by numerous vertical cracks and fissures. A bed

SIPHONIA BENSTEDII (Lower Greensand)

[In the Collection of W. Bensted, Esq.]

True, the "*Upper* and *Lower Bagshot Beds* are not noticed" in my Table; for the simple reason, that they cannot be regarded as good "Marine Types," like the Barton and Bracklesham Clays: one contains only a few vegetable (Terrestrial) remains; and the other rarely any fossils, except in one place, where, however, they are "in too friable a condition to bear transport or examination." (See Jukes's Manual, 1st ed. pp. 527 and 531; also Phillips's Manual, p. 387.)

In placing certain "marine and fresh-water types" on "the same line," the object was to show that they may be *approximately* "of the same age."

When "W. W." takes on himself again

> "To spy into abuses, and shape faults
> That are not,"

or to "point out" the "many other mistakes" which he fancies I have committed, I would feel obliged by his showing the relation between the Lower Green Sand and the Atherfield Clay. At the friendly suggestion of the Editor of the 'Geologist,' I have inserted, in a new edition of the Table, now printing as a separate sheet, the Lower Green Sand, placing it at the bottom of the Cretaceous System.

Permit me to embrace the present opportunity of making a few corrections before closing this letter. The name *Rhyncopora* in my Table (proposed for a genus or sub-genus, typified by De Verneuil's *Terebratula Geinitziana*, the peculiar characters of which were described in my "Notes on Permian Fossils," published in the 'Annals and Magazine of Natural History' for April, 1856) should have been spelled *Rhynchopora*. "Somerset *Teleosaurus* Upper Lias," suggested by my friend Mr. C. Moore, of Bath, was by some mistake placed in the Jurassic instead of the Liassic System.

In my paper "On the Origin of Species," contained in the last number of the 'Geologist,' a slight mistake has occurred. The first line of the sixth paragraph ought to have been—"There is no difficulty in referring *to* instances,' etc.

I am, dear Sir, yours very faithfully,

WILLIAM KING.

Belmont, near Galway, July 4, 1862.

Tertiary Mammalian Remains at Dulwich.

SIR,—It may be interesting to your readers to know that I have lately found a front tooth (incisor or small canine) of a mammalian animal from the Woolwich Beds, near Dulwich, exposed some time since by the works for the southern high-level sewer. Mr. Rickman has found some bones he calls mammalian, but there is a doubt as to their being such.

Yours, etc.,

A. BOTT.

5, *Hanover Terrace, Peckham,* 11*th July*, 1862.

Sicilian Bone-Caves.

SIR,—I hasten to give that explanation of the error or rather confusion in my Table which Dr. Falconer, as the original describer of the Grotta di Maccagnone, has a right to demand.

The column marked "Maccagnone" should have been headed "Maccagnone and San Ciro," and the species inserted therein are those derived from both localities.

The *Felis, Ursus, Hyæna, Bos, Hippopotamus*, and *Cervus* have been hitherto not referred to their species by Dr. Falconer. To obviate further mistake, I append a list of the species derived from both bone-caves, as stated in Dr. Falconer's paper (Quarterly Journal, Geol. Soc. vol. xvi. 1860, p. 99 *et seq.*):—

San Ciro Cave, Two miles from Palermo.	Maccagnone Cave, A mile west of Carini, near Palermo.
Felis, a large species.	*Felis*, "as large as F. spelæa, but not yet specifically determined."
Canis.	
Ursus.	*Ursus*.
	Hyæna.
Cervus.	*Cervus*. } two species.
	Do.
Bos.	
Sus.	
Elephas antiquus.	*Elephas antiquus*.
Hippopotamus. } two species.	*Hippopotamus*.
Do.	
	Bones of Ruminants.

The liability in a table of this kind to error is obvious, when the exigencies both of space and time are duly considered.

Before the unenviable employment is commenced by me of "a wholesale manufacture of species," I shall wait the further identification of the specimens from the Sicilian bone-caves by Dr. Falconer.

Yours truly,

Charles Carter Blake.

Origin of Species.

Sir,—In the July number of the 'Geologist' is a letter from Professor King, of Galway, expressing the opinions to which that high authority has arrived, after years of due thought and consideration, on the probable method of operation of continuously-operating secondary laws, which have produced the species of animals successively or progressively throughout geological time. While paying the highest tribute to the candid manner in which this eminent geologist has treated his subject, I am led to suggest that the meaning of one passage in his admirable paper may be liable to misconstruction.

Professor King holds "that an organism, whether it typifies a species, a genus, a family, an order, or a class, is an autotheogen, if it possesses a series of characters which isolate it from other equivalent groups;" and that inherent and external forces may modify such organism, "thereby resulting in geneotheonomous forms." The limits within which autotheogeny can be predicted are, however, left unexplained by Professor King.

A writer in 1830, reasoning from the philosophical standpoint of the state of knowledge in the time of Cuvier, would have confidently pointed to the horse as an "autotheogen." Cuvier says, "If species have gradually changed, traces of these gradual modifications would be discovered; and between the *Palæotherium* and the recent species some intermediate forms would be seen; a fact yet undemonstrated. Why have not the bowels of the earth preserved the monuments of so curious a genealogy?" etc. etc. (Cuvier, 'Discours Préliminaire sur les Révolutions de la Surface du Globe,' 6th edition, 8vo, Paris, 1830, p. 122.) Here the absence of intermediate organisms, previous to the discovery of *Paloplotherium*, *Anchitherium*, and *Hipparion*, is made the groundwork on which to base a theory of distinct specific origin, or "autotheogeny." That, "on psychological grounds alone, Man must be regarded as isolated from all other organisms" may be conceded. As psychological grounds however are unsafe bases for a zoological classification, and as the extent of man's isolation is the problem which biologists are attempting to decipher, whatever position we may assign to man, whether with Owen in a distinct subclass *Archencephala* or with Huxley in a family *Anthropini* of the order *Primates*, we must at least admit that the anatomical characters of man are not more unlike those of the higher *Gyrencephala* than the lower *Gyrencephala* are unlike the *Lissencephala* or *Lyencephala*, *i.e.* that man is not more unlike the gorilla than the whale is like the rat or the opossum. I therefore would be slow to recognize that Man is an autotheogenous species.

I coincide with Professor King's remarks, that "natural selection only holds the rank of a subordinate or ancillary agent," but I am far from identifying the "other and higher principles involved" with the doctrine of direct creation of animals through a fiat from a Primary Cause, even though such a fiat might operate through "a principle inherent in animated nature." Such phenomena as unity of plan, parthenogenesis, and successive development are far more probably accounted for on secondary laws alone. "He must be a half-hearted philosopher who, having watched the gigantic strides of the biological sciences during the past twenty years, doubts that science will sooner or later make this further step, so as to become possessed of the law of evolution of organic forms—of the unvarying order of that great chain of causes and effects of which all organic forms, ancient and modern, are the links." *

In Professor King's ethnological remarks, no mention is made of the probabilities of a derivative origin of the lower races of man, as indicated by their physiological affinities to the higher apes. I commend the following extract from Dr. Büchner's 'Kraft und Stoff' (8vo, Frankf. p. 75, 1858) to Professor King's consideration:—

"An unbroken series of the most varied and multifarious transitions and analogies unites the whole animal kingdom together, from its lowest to its highest unit. Even man, who in his spiritual pride thinks himself raised high above the whole animal world, is far removed from being an exception to this law. The Ethiopic race unites him by a crowd of the most striking analogies with the animal kingdom in a very unmistakable way. The long arms, the form of the foot, the fleshless calf, the long slender hands, the general lankness, the but slightly protuberant nose, the projecting teeth, the low retreating forehead, the narrow and posteriorly protuberant head, the short neck, the contracted pelvis, the pendulous belly, the want of beard, the colour of the skin, the disgusting odour, the uncleanliness, the making of grimaces whilst speaking, the clear shrill tone of voice, and the ape-like character of the whole being, are just so many characteristic signs, which in all the corporeal forms and relations of the

* Huxley, Address to the Geological Society, Feb. 21, 1862, p. 23.

negro unmistakably show the most decided approach to the monkey genus." The same author goes on to say, "Without doubt, man in his earlier periods approached in his whole character nearer to animals than he does in his present condition; and the oldest excavated human skulls indicate rough, undeveloped, and animal-like forms."

Such conditions as these, agitating and seething in the minds of patient observers and reflective thinkers in France and Germany, are being forced upon the minds of Englishmen. Our best thinkers now refrain from offering any theological or metaphysical explanation of geological facts.

I trust that Professor King, whose valuable tables of strata as recently published in the 'Geologist' have had so beneficial an effect on science, may be ultimately led to reject the unphilosophical theory of "autotheogeny."

The doctrine of "Geneotheonomy," or the "Derivative" hypothesis of animal causation, is now fast converting the minds of all palæontologists. Amongst its supporters can be numbered* Lamarck, Geoffroy St. Hilaire, Grant, Matthew, Rafinesque, Haldeman, the author of the 'Vestiges of Creation,' D'Omalius d'Halloy, Owen, Isidore Geoffroy St. Hilaire, Dr. Freke, Herbert Spencer, Naudin, Keyserling, Schauffhausen, Baden Powell, Wallace, Huxley, and Hooker. To these may be now possibly added those of Lyell, Fawcett, Lubbock, Mackie, Salter, Rupert Jones, Blake, Büchner, Schvarcz, Knox, Burke, Hutton, King, and many others.

To accept, in 1862, the doctrine of the origin of species by creative fiat out of inorganic matter, is as unphilosophical as to believe in the theory of earthquakes given out by the Muyscas of New Granada, that the earth is supported by pillars of *guaiacum*, on the shoulders of the deity Chibchacum, who, being tired, shifts the weight from one shoulder to another;† or to the Egyptian theory, that the earth, during earthquakes, is tossed from one horn to another of a gigantic cow.‡ Such theories are fast disappearing in the minds of those who, with Comte, "substitute the study of laws for that of causes, the *how* for the *why*."

I am, Sir, your obedient servant,

MICROLESTES.

Monography of the Geological Survey.

Dear Sir,—Will you be kind enough to inform me, through your Magazine, if the plates to Monograph I. of the Memoirs of the Geological Survey are issued or likely to be issued soon? The Monograph itself (on Pterygotus) is published without a word of notice as to when the plates are to be published, although they are referred to in the body of the paper.

It seems to me there is a great want of energy about the Government Geological Survey in the matter of the publication of their Decades and Monographs. On the covers of the work alluded to it is constantly announced that "Other Decades are in the press;" whilst years elapse between the publication of two small Decades. Were the undertaking car-

* List from Darwin, 'Origin of Species,' 3rd edition, 1861, p. xiii.: "Historical Sketch of the recent Progress of Opinion on the Origin of Species."

† Bollaert, 'Antiquities and Ethnology of South America.'

‡ Pouchet, 'Pluralité des Races Humaines.'

ried out in the spirit of Sir Henry De la Beche's preface to the first Decade, palæontologists and naturalists generally would benefit very greatly by a work so remarkable for the beauty and accuracy of its figures and the completeness of its descriptions.

I dare say most palæontologists would not object to receive one Decade or Monograph at the least every three months.

I am, Sir, your most obedient servant,

R. Lechmere Guppy.

Port of Spain, Trinidad, 19th June, 1862.

GEOLOGICAL NOTES IN THE GREAT EXHIBITION.

In a few months—and how soon they will fly away!—the great show of the world's industry, that daily attracts its tens of thousands of visitors, will have closed for ever, and have become like many other beautiful things—an item of the oblivious past. As the dulcet sounds of music pass away and are never heard again, although fresh lips or fingers may bring forth other sounds as tender and as sweet, so from our eyes this exquisite vision will pass, and if in future years other and nobler displays shall take its place, *this* glorious scene will truly be no more. How much material of high interest for the geologist is there! as there is for the naturalist and ethnologist; as there is for every thinking mind, for every inquiring intellect. In these notes it is not our intention to attempt to detail *all* the geology that may be learnt within those miles of walls, the catalogues show what a volume would be needed for this; nor is it our wish to fill our pages with expatiations on the wonderful scenery. The work of the navvy and the mechanic, the work of the labourer and builder is the work that endures. We attempt to harvest in the fields of facts which other men have there recorded; facts written down for the present occasion for *their* purposes; facts which we wish to gather for our science. We have mineral materials from all parts of the globe. Who has described them, figured them? Plants, trees, woods, animals, skins, bones, gems, and metals conveying years of information to the student. Surely in these fields we may gather as much as we are able of such goodly seeds of knowledge.

First, in walking through the courts, how many noble samples of our nation's great sources of power and wealth, coal and iron, have we seen? Samples of many or of most of them we *may* have seen before, for they are of daily use, some or other hourly before us; but when have we seen such samples so instructively placed? Where have we seen them accompanied and illustrated by such instructive plans and sections?

We have pondered long *how* we should *best* place these various matters before our readers, and at last we have resolved to gather the good seed wherever we can find it, and to take it as it stands, to gather it as it is, and to store it in our volume for everybody's use. This we *must* do, or lose it altogether. Our readers may thrash it, grind it, do what they will with it; but unless we bring it in it will perish thriftless in the field where it stands. What we intend to do, then, is to take note of whatever is valuable as we meet it, we shall not attempt more. As we find good facts we shall write them down—ay, in the Exhibition itself—and send them, then and there, direct to our printers.

Mineral Resources of Tasmania.—The bold greenstone and basaltic mountains of Tasmania, formerly known as Van Diemen's Land, their summits capped for many months in the year with snow, form striking objects from whatever quarter the island is approached. The central part consists of a table-land, averaging 3000 feet above the sea, and on which are seven lakes, in size from 2500 to 50,000 acres, and in the aggregate equal to 112,000 acres of fresh water. These lakes form the sources of many considerable rivers.

The undulating country between the lofty table-land and the sea is covered with forests of gigantic trees, extending from the hill-tops down to the water's edge. The Tasmanian Commissioners speak of the mineral resources of that island as encouraging hopes of great advantages, especially in respect of coal, of which numerous samples are exhibited from various localities,—coal being, indeed, very generally distributed throughout it; time and the assistance of capitalists being all that is needed for its commercial development. The main part of the fuel used in Hobart Town is derived from the mines of New Town, and from the Tasman's Peninsula; but it is generally believed that better beds exist in other districts. Public attention has been of late much directed to Mount Nicholas. The seam there locally known as the "Kelly Moon seam" breaks out at a height of 500 feet above the Break o' Day Plains, about nine miles from Falkirk, and can be worked by an adit-level. The coal is highly bituminous, and is said to be well suited for steam, gas, and domestic purposes. The same seam crops out near Fingal, and other places. This coal-bed is believed to extend over an area of fourteen square miles on the north of the Break o' Day Plains. Samples of bituminous coals are also exhibited from Douglas River and Long Point (6 ft. 10 in. thick), on the east coast; from Mersey River; from Hamilton, about twenty miles distant, where a very good coal (4 ft. 6 in.) lies 40 feet deep.

On the southern side of the island anthracite is abundant, and samples are shown from New Town, Tasman's Peninsula, Adventure Bay in Bruni Island, and from Three Hut Point in D'Entrecasteaux Channel. The coal at Tasman's Peninsula has been worked for twenty-five years, and the seam, 3 ft. 6 in. to 4 feet thick, is got at by a shaft 75 feet deep, and within 100 yards of the water's edge. A new seam has been struck here, said to be of the highest quality. The coal formation of the south side of the island extends round the mouth of the Huon to South-west Cape. The labours of Mr. Gould, the Government geologist, have of late been almost concentrated on the coal-bearing deposits, and a commission was appointed by the Parliament, in March last, for testing the comparative values of the products of the various localities. The metal collections comprise gold, which exists in various parts, especially in the Fingal district; but not, as far as is yet known, in anything like such richness as has made Australia and California such temptations for adventurers.

To stimulate exploration, the Colonial Government has offered a reward of £20,000 for the discovery of a remunerative gold-field. There are abundance of quartz-reefs in the Fingal district, more or less auriferous, some of which will probably eventually pay for crushing. Galena and copper-ore have been found in different parts, but not hitherto in any considerable quantity. Iron-ore abounds all over the colony. At Ilfracombe, eight miles from the Tamar, there are immense masses of rich ore which will doubtless prove highly advantageous, in connection with the coal-fields of the east coast. It is said to be nearly identical with the brown hæmatite of Mittigong, in New South Wales. Count Strzelecki, in his excellent work on New South Wales and Van Diemen's Land, draws a comparison between the agricultural capabilities of the two countries, from a consideration of the origins of their respective soils: the crystalline rocks, such as granite, compared with the sedimentary rocks in New South Wales, being as 3 to 1, while in Tasmania they are as 7 to 1. Of rocks having more than 60 per cent. of lime as compared to rocks with less, the proportion in New South Wales is 4·1 to 1; in Tasmania the case is reversed, the proportion 1 to 3. Count Strzelecki attributes this difference to volcanic agencies, which have been more prevalent in Tasmania than in the Australian continent. Some specimens of serpentine veined with asbestos, from the Asbestos Hills, show themselves susceptible of a high degree of polish. Black and white marbles from the Florentine Valley and from Chudlegh are shown; and of building stones, specimens from numerous quarries are exhibited by Mr. Calder; there are also some grindstones of large size and fine quality, and some smaller ones said to be eminently suitable for glass-cutting. The beautiful marbles exhibited have hitherto only been used for making lime, but properly polished they will be well suited for internal architectural decorations. Topazes are exhibited from Flinders Island.

Pembrokeshire Anthracite.—From Broadmoor Colliery, near Tenby, and Landshipping Colliery, Haverford West (South Wales). *Analysis*:—Carbon 93. Hydrogen 3·08. Azote ·54. Sulphur ·68. Oxygen 1·67. Ash 1·03. The following is the order of the strata:—

Broadmoor.	Landshipping.
	1. Argillaceous arenaceous shales with abundant nodules of ironstone.
	2. "Bright Vein," about 4 ft. 6 in. of *culm*, of a clear bright aspect.
	3. "Dunstone," or Fire Clay.
1. Yellow magnesian sandstone, or limestone.	4. Yellow magnesian sandstone, with a few bands of shales.
2. "Rock Vein," about 3 ft. of good *anthracite*.	5. "Rock Vein," about 2 ft. 6 in. of good *stone coal*.
3. Dunstone (Fire Clay).	6. Dunstone (Fire Clay).
4. Argillaceous and arenaceous rock with nodules of ironstone.	7. Dark argillaceous slate, or slaty earth.
5. "Low Vein," 1 ft. 8 in. of inferior *culm*.	
6. Fire Clay.	
7. Hard siliceous rock with a few argillaceous bands.	
8. Argillaceous slate with bands of ironstone.	
9. **"Timber Vein,"** varying from 7 to 10 feet thick.*	8. **"Timber Vein,"** an anthracite seam varying from 6 to 8 feet.
10. Fire Clay.	9. Dunstone (Fire Clay).
	10. "Little Vein," 1 ft. 8 in. of culm.
	11. Dunstone (Fire Clay).
	12. Compact argillaceous rock with some bands of iron-ore.
	13. Hard siliceous and calcareous rock about 2 feet.
	14. "North Vein," 1 feet 3 inches to 1 ft. 6 in. of anthracite.

There are several small seams of *coal* below the "Timber Vein," the largest and most important of which are "the Lower Level" (= 1 ft. 8 in.) and the Kilgetty (= 1 ft. 8 in. to 4 feet), considered the best anthracite. The former is about 70 fathoms below the "Timber Vein," and the latter

* The beds printed in black letter are those of which samples are in the Exhibition.

about 45 fathoms still deeper. The entire basin is about 1500 feet in thickness, with about 20 seams, containing about 28 feet of anthracite coal "stone," or smokeless fuel, and about 123 beds of ironstone, varying from 1 to 4 inches of argillaceous iron-ore, averaging 30 per cent. of iron.

(*To be continued.*)

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

Geological Society of London.—*June* 18, 1862.—1. "On the Mode of Formation of some of the River-valleys in the South of Ireland." By Professor J. B. Jukes.

Mr. Jukes's paper contained a description of the physical structure of that part of the South of Ireland south of the limestone-plain that extends from Dublin to Galway Bay. He showed that the Rivers Shannon, Barrow, Nore, and Suir, after traversing this low ground, escaped to the sea by ravines worn through lofty hills of Old Red Sandstone and Lower Silurian rocks. He also instanced the rivers Blackwater, Lee, and Bandon as each suddenly deserting the low longitudinal valleys through which they had run for many miles, and turning at right angles down ravines of Old Red Sandstone, notwithstanding the fact of the longitudinal valleys being continued with no apparent obstruction to the course of the rivers. He showed the connection of these lateral ravines with the coming of strong brooks from the higher ridges on the north into the longitudinal valleys, and also that these brooks probably produced the ravines, having first begun to erode them over a surface above the present ridges, and before the formation of the longitudinal valleys.

He considered the fact proved, that the present "form of the ground" in the South of Ireland was produced by atmospheric erosion on dry land; and that the limestone ground was low because the rock had been dissolved chemically as well as eroded mechanically; and that its surface had sunk to a lower level than the other rocks, like that of a glacier melting in its bed. He proposed to extend this explanation generally to all dry land.

2. "Experimental Researches on the Granites of Ireland.—Part III. On the Granites of Donegal." By the Rev. Professor S. Haughton.

The author described in detail the geographical position, physical structure, geological relations, and the chemical and mineralogical composition of the granite of Donegal, which consists of four minerals—quartz, orthoclase, oligoclase, and black mica, with perhaps an unknown paste besides. The oligoclase affords evidence of the probable identity of the granite of Donegal with that of Northern Scotland and of Norway. The author also alluded to his success in obtaining a formula for the determination of the proportions of *four* minerals in a compound rock, from the relative specific gravities of the mass and of its constituents.

3. "On a Stalk-eyed Crustacean from the Coal-measures." By Professor T. H. Huxley.

This specimen, in an ironstone nodule, is crushed laterally, and exhibits a side view of a Crustacean, similar in all essential respects to *Pygocephalus*. The chief interest attaching to the specimen lies in the confirmation which it affords of the author's interpretation of the specimens on which the genus was founded. He draws the attention of collectors to the occurrence of Crustaceans of such high rank in Carboniferous rocks.

4. "On the Premolar Teeth of *Diprotodon*, and on a New Species of that Genus from Queensland in Australia." By Professor Huxley.

Among a collection of fossil bones from the Darling Down district, in the possession of Dr. Cotton, F.G.S., the author has observed a portion of the right ramus of the lower jaw of *Diprotodon*, and parts of the right and left upper jaws, with the anterior grinders in place, of distinct individuals. Hence he was enabled to offer some observations on the dentition of the genus, and more particularly upon the characters of the premolars. For the form which he finds distinct from *Diprotodon australis* he proposes the name of *D. minor*.

5. "On the Old Red Sandstone of Fifeshire." By James Powrie, F.G.S.

Having again examined some sections of the Old Red at Whiteness, near Arbroath, and elsewhere, the author is satisfied of a local unconformity of the Upper on the Lower Old Red, but that no other locality in Forfarshire exhibits this want of conformity; and neither in Fifeshire nor Perthshire does the author find a section distinct enough to exhibit such a break in the series. Mr. Powrie alluded to the yellow sandstone of Dura Den, and observed that though it is unconformable to the red sandstone beneath, yet he believes that it belongs to the Old Red Series. He proceeded to notice the fossil fishes of Dura Den, of which he says there are six well-marked genera (including *Glyptolepis*) with about seven or eight species.

6. "On some Upper Coal-measures, containing a bed of Limestone, at Catrine, in Ayrshire." By E. W. Binney, F.R.S.

Some red and purple strata near Catrine, underlying the Permian breccia of Ballochmoyle, were referred to in 1856 by the author. He has since revisited the locality, and finds that these strata at Ballochmoyle Braes, Catrine, and Sorn represent a coal-field as high as any in the English series; in fact, similar to those at Ardwick near Manchester, Uffington, Leebotwood near Shrewsbury, Buxtaby near Nuneaton, and Lane End Potteries. Mr. Binney referred to the observations made by Mr. Ralph Moore, and by Geikie and Murchison, and pointed out how far he differs from them. Mr. Moore gives 565 fathoms for the whole series in Ayrshire; the author finds reason to add nearly 300 fathoms of Carboniferous strata (not productive of coal) to the above estimate.

7. "On the Geological Structure of the Southern Grampians." By Professor James Nicol.

The author stated that in 1844, and in subsequent years, he indicated that the Silurian strata of the South of Scotland are represented in the North by the metamorphosed or so-called primary strata; and he proceeded to point out that the object of the present communication is to examine the relation which the three great formations, Clay-slate, Mica-slate, and Gneiss bear one to the other as regular constituents of the crust of the earth, and especially in certain parts of the Scottish Highlands, as illustrated by sections observed by himself. These he correlated with what is seen in other parts of the Highlands.

Contrasting his published sections with the corresponding ones given by Sir R. I. Murchison and Mr. Geikie, he observes that, though represented as maintaining the identity of the gneiss of the west coast with certain mica- or chlorite-slates, yet he has in former papers, and in his published map, always regarded them as being identical only so far as both belong to the great series of metamorphic formations inferior to the red sandstone and quartzite, but still as distinct formations with peculiar features, and, it may be, of widely different age.

8. "On some Natural Casts of Foot-prints from the Wealden of the Isle of Wight, and of Swanage." By S. H. Beckles, F.R.S.

Some of these natural casts are nearly $3\frac{1}{2}$ feet long, indicating not merely the imprints of the toes, but also of the sloping metatarsals. The animal must have been of great size and weight, leaving deep imprints. Little trifid imprints of only 3 inches in length, with a stride of about 13 inches, occurred to the author also in the Isle of Wight. He has found, also, trifids of the usual size in the Wealden of Swanage Bay. Mr. Beckles argued that other Dinosaurians besides the *Iguanodon* have left these track-marks; and he stated that from the first he has been accustomed to associate them with the various phalangial bones so abundant in the Wealden.

9. "Geological Notes on Zanzibar." By Richard Thornton, Esq.

From the coast to the coast-range (600 to 1300 feet high), the country consists of a series of strata with an easterly dip, namely (from above downwards), coral-limestone, sandstone, yellow shale, and sandstone with plant-remains. The mountain Kilimanjaro is formed chiefly of volcanic rocks. White and altered sandstones, with easterly dip, are met with also in the Massai Plain.

10. "On a Section at Junction-road, Leith." By W. Carruthers, F.L.S.

The author stated that in the section of clay, sand, and gravel near Leith, described by Mr. Geikie as part of a raised beach elevated since the period of the Roman occupation, not only have mediæval pottery and tobacco-pipes been found in the pottery-bearing deposit described by Mr. Geikie, but a mediæval jar has been met with in the sand beneath. The so-called "Roman" pottery was stated by the author to be of mediæval age, on the independent authority of Messrs. Birch and Franks, of the British Museum; and he believes that the beds in question are mainly of late and artificial formation; he does not, however, argue from this that there is no evidence of a late upheaval of the central part of Scotland.

11. "On the Death of Fishes in the Sea during the Monsoon." By Sir William Denison, Governor of Madras, etc.

Steaming between Mangalore and Cananore, on the west coast of India, the author found that for some time after the south-west monsoon the sea was offensive with dead fish, killed by the great mass of fresh water poured into the sea during the season of the monsoon.

Specimens of *Elephas Melitensis* and *Myoxus Melitensis*, obtained from bone-caves in Malta by Captain Spratt, were exhibited by Dr. H. Falconer.

Manchester Geological Society.—*May* 27.—Mr. Binney read "An Account of the Excursion to Todmorden." On reaching Todmorden, the party proceeded along that beautiful valley to Gauxholme, over strata belonging to the lower portions of the millstone grit. At the entrance of Dulesgate strong gritstone rock was seen dipping at a considerable angle N.W., and exhibiting shakes and faults. On Pendle Hill, beyond Burnley, and at Tintwistle, near Glossop, are two natural sections which can be pretty well measured, especially the latter, where, between Rhodes Wood Quarry in the valley, and the thick bed of rock at Tintwistle Nar on the hill, are from 700 to 800 feet of strata. The whole of the deposits between the limestone shale and the upper millstone of the Lancashire geologists (the Brooksbottom Sandstone) may be taken at 1200 feet in thickness. These beds probably attain their greatest development in Lancashire, Yorkshire, and Cheshire. Returning again to the Gauxholme Rock, a small seam of coal was observed, and at a further distance up the valley another bed of a few inches. From the entrance of the valley to the quarry on the right of the route (probably at the base of the Brooksbottom series of coals) cannot be here less than 1000 feet. The Haslingden flags are then seen, but not of great thickness or good quality. Then the "rough rock," with the Feather-edge coal, 14 to 16 inches thick, lying imbedded in its upper portion. Above this were the "Foot Coal," the "Salts," and the "Spanish Juice" seams. The "Gannister" coal was next met, 5 feet 6 inches in thickness, and containing "bullions" in the coal, the same as the Spaw Clough, Town Head, and Carry Heyes Mines of Burnley, with nodules in the black shales of the roof full of *Aviculopectens*. *Goniatites*, etc. About ten yards above is a small seam of a few inches, and then comes the "forty yards coal," twenty inches in thickness, with a fire-clay floor worked for bricks and tiles; further up is another small seam of a few inches, and then the upper or "Old Lawrence" series of flagstones. To the left of the quarry, the strata are thrown up by a fault of fully a hundred yards, and the Rochdale coal is wrought by a tunnel through it.

The Moor was then crossed near the Flag Quarry; the party next passing the fine cliffs of "rough rock" above Portsmouth. In the valley a cutting of the Burnley Railway has exposed an interesting section of some of the Brooksbottom coal measures, showing a small fault; and beyond Messrs. Fielden's mill some old workings in the Gannister coal, which is there brought up by a fault of 400 to 500 yards east, were seen.

2. "Communications respecting Safety Lamps." By Mr. C. Bass, and Messrs. J. Abbott and Co.

3. "Descriptions of Water-Balance Machines used for Winding Coal, Ironstone, etc., in South Wales." By J. Evans, Esq., Inspector of Mines for South Wales.

4. "Explanation of Model of New Safety Cage for Miners." By the President.

Mr. Farrimond exhibited a specimen of *Sternbergia*, and a rounded piece of white quartz, found in the centre of the Lower Mountain Mine, Dunkenhalgh Park, near Church. Mr. Binney remarked that these pebbles were once thought to be rare in coal, and in twenty years he had found but two of them; but from Dunkenfield Mr. Dickinson and Mr. Ray had brought a barrowful, and those were now in the Society's Museum. A valuable collection of fossil fish from South America was presented to the Society by Mr. Eddowes Bowman.

NOTES AND QUERIES.

Anthracite in Silurian Rocks.—In the abstract of the lecture "On Coal" at the Royal Institution, printed in our last number, Mr. Warington Smyth is stated to have discovered anthracite coal at Laxey Mine in the midst of ancient schists, probably Lower Silurian.

This is not the first case of the observation of seams of bituminous matter in strata older than the coal-measures. We have long had by us a pamphlet on the occurrence of anthracite in the Silurian strata of Cavan, by Dr. Whitty, of Dublin, who brought that instance under the notice of the British Association and the Dublin Geological Society, in 1854. In that year, Dr. Whitty visited the townland of Kill, a mile west of Kilnaleck, in Cavan. The rock throughout the district he describes as belonging to the "Grauwacké Slate formation,', having an average strike of 57° E.W.E. (true meridian), and a dip at the place in question 80° S.E. "This," he says, "is not the true coal-formation, as every geologist knows, yet a bed of soft anthracite or culm occurs here, about four feet in thickness, in a dark grey clay-slate, having the same dip-strike as the accompanying rocks." The "Grauwacké" of this part of the country consists generally of stone-grey rock, alternating with beds of slate; the thickness of the masses of each kind being very variable, in some cases a few inches only of slate or hard rock, in others from fifty to a hundred feet of either. Some of the hard masses contain pebbles, usually about the size of a pea, but often as much as one or two inches in diameter. Occasionally the rock is massive, and so much altered by metamorphic action, that were it not for the pebbles it might be mistaken for a greenstone.

A case similar to this was reported by Professor Harkness to the British Association in 1852, "at Rattenside, near Greskin, about four miles above the Beatock station on the Caledonian Railway; the anthracite is seen in the Evan Water, and this can be traced E.N.E. to Hartfell, and from thence into Peeblesshire and Selkirkshire." Of the rock which contains it he says, "This slate extends E.N.E. and W.S.W. It is seen at Stobo, in Peeblesshire, and in the summit cutting of the Caledonian Railway, where it shows great thickness. From thence it extends westward through Lanarkshire and the north-east of Dumfriesshire to Cairn Ryan, in Wigtonshire."

Dr. Whitty thinks, that "as those Silurian or Grauwacké rocks of the Pentland Hills and south of Scotland are admitted to be the counterpart of our Grauwacké rocks in the North of Ireland, and are in fact a continuation of the same formation, it is more than probable that the anthracite of the county of Cavan is a production of the bed in Scotland, and extends all the way between them, through the counties of Down, Armagh, and Monaghan." A trial pit was sunk by Dr. Whitty at Kell, and a specimen of the anthracite analysed: its composition being carbon 77·64, water 4·35, ash 18·01 (=100·00). "It contains no bitumen, and therefore is ill-suited for ordinary domestic purposes, but would answer well for burning lime or bricks and drying malt, when mixed with a small portion of bituminous coal or turf to ignite it. Once made red, it gives out a powerful heat, and continues it a great length of time. It will also be found most efficient for smiths' work."

It is well worth while to keep these facts before the geological world; and it should not be forgotten that in the south of Scotland graptolites are very prevalent in the anthracite, or rather in the anthracite shales.

FURTHER NOTES ON HUMAN SKULLS FROM HEATHERY BURN CAVE, WEARDALE, DURHAM; WITH A NOTICE OF THE RIVER-BED SKELETON FROM LEICESTER.—I have been asked to give a few supplementary remarks on the fragmentary human remains from this cave, in addition to those made by Professor Huxley ('Geologist,' vol. v. p. 201). The observations made by him led him to express an opinion that the Weardale remains belonged "to the same race of rather small and lightly-made men, with prominent superciliary ridges and projecting nasal bones," as the Muskham, Towyn-y-Capel, Sennen, Borris, and Blackwater skulls. In the spirit of these observations I cordially concur.

Particular description of the remains being, however, requisite, I proceed to remark that no perfect skull has hitherto been found in the Heathery Burn Cave. The most perfect, though not the most characteristic, is the one of which Mr. Mackie has given an excellent drawing (p. 201), and which I shall denominate A. Another skull is only represented by the *os frontis* and a small part of the parietal, and is far more striking. I name this B for facility of description.

The calvarium, or vertex of a skull marked A, is not that of an aged individual. A large part of the frontal suture is persistent. The frontal region is low, but not markedly retrocedent. An even curve is continued backwards to immediately behind the coronal suture, when the same "post-coronal" depression is visible, as in the Mewslade and Eastham skulls. The points of attachment of the temporal muscle are scarcely visible. The coronal suture is, however, complex at the spot where it crosses the temporal attachments,—a character on which Messrs. Thurnam and Davis have laid stress in British skulls. The parietal tubers are moderately prominent. The superciliary ridges are not unduly developed, and the fractured condition of the skull warrants us in affirming that the frontal sinuses were small. As far as measurement can be made, the length from the glabella to the apex of the lambdoidal suture is 7 inches; the breadth at the parietal tubers, $5\frac{1}{8}$ inches; at the coronal suture, $4\frac{1}{2}$ inches; above the orbits, $3\frac{5}{8}$ inches. A fragment of right occipital condyle probably belonged to the same young individual; a fragment of the mastoid bone appertained to an elder person.

The fragment marked B is a most striking relic of antiquity. It is the frontal bone, with much of the right parietal attached: the pieces of which I have succeeded in joining together. The close similarity of it to the fragmentary skull from Plymouth, which Professor Busk has described, and I have figured from his plate ('Geologist,' vol. v. p. 212), must strike every observer. Unlike, however, the Plymouth skull, the superciliary ridges are markedly conspicuous. The retrocession of the forehead is very peculiar, and strongly resembles that in the skulls from Sennen and Muskham. Slight traces of the frontal suture can be seen. The frontal sinuses are present, though small. No traces of the post-coronal depression are visible. It is much to be regretted that no other pieces have been preserved of this curious skull. Many fragments, chiefly of parietal bones, were also obtained; but their condition precludes an opinion as to their nature. The vertebræ and bones of the extremities did not offer any characters calling for especial notice.

I believe that the fragment marked B was the skull which Mr. J. Elliott, the careful explorer of the cave, stated* "may have been that of one of the principal tenants of the cave, and which probably devoured the others." This evidence of "a tolerably large animal" rather appears to be that of a human being with forehead "villanously low," and whose cranial characters were so striking as almost to excuse the error into which Mr. Elliott was unintentionally led.

The skull from Leicester is in good condition, and retains much of its animal matter. It exhibits the even oval contour characteristic of the existing type of Englishmen. By the smallness of the mastoid processes, the slenderness of the zygomata and the slight degree in which the surface is pitted with muscular depressions, I conjecture it to have belonged to a female, and by the position of the wisdom teeth (*m* 3) in the alveoli, the individual probably did not exceed eighteen years of age. The following is a table of the principal admeasurements:—

	Inches.
Longitudinal diameter	7
Parietal diameter	5
Frontal diameter.	$5\frac{1}{4}$
Vertical diameter	$4\frac{5}{8}$
Intermastoid arch	$13\frac{1}{4}$
Intermastoid dine	$3\frac{3}{4}$
Occipito-frontal arch	14
Horizontal periphery	$19\frac{3}{8}$

* 'Geologist,' vol. v. p. 36.

The slope of the frontal and parietal bones is even and round, the occiput being full and globular, without any sign however of the "kumbekephalic" backward prolongation.

Comparison of the base of the skull with that in a well-formed European of about the same age, exhibits the prognathism of the maxilla more distinctly. The incisor teeth are rather more oblique, and the extero-internal breadth of the canines is greater than in the majority of existing European crania. The molar teeth do not exceed in size the average European proportions. Many of them were afflicted during life with caries to an alarming extent. The frontal bone is moderately arched, the glabella prominent, with no sign of the supraciliary ridges. All the sutures exhibit the normal configuration.

The ordinary junction of the alisphenoid with the parietal is present on both sides the skull. The mastoids are small, and the supramastoid ridge is undeveloped. No peculiarity exists in the form or position of the occipital foramen or of the condyles. The nasal bones are well-developed and rather salient.

The lower jaw does not exhibit any marked peculiarity.

The appearance of the lower half of the supraoccipital bone is very different from that of the Muskham skull. The surfaces for attachment of muscles are less pronounced; the furrow for the insertion of the *obliquus superior* muscle is less deep; the crest, and the superior and inferior *lineæ semicirculares* are less developed, and the occipital protuberance, or inion, is less distinct. A small paroccipital tubercle is visible on the right side. The upper half of the supraoccipital is full and globular, and in the rather complex lambdoid suture are at least seven wormian bones, none of which however deserve the term interparietal.

An examination of the nearly perfect spinal column did not disclose any peculiar characteristic. The bones of the extremities indicate a youthful individual, the epiphyses being in many cases separate.

The animal remains said to be associated with this skull were *Bos primigenius* and *Equus caballus*.

The following table is merely offered as a temporary and provisional arrangement. Many of the sections do not represent distinct races, and all the skulls from the river-bed deposits offer many points of analogy with each other. The difficulty of laying down any general system can only be appreciated by the practical inquirer. In the meantime, the evidences appear to be capable of arrangement in something like the following order:—

1. Dolichocephalic.
   - A. Forehead retrocedent.
     - a. Superciliary ridges very large, continuous over nasal suture. *Neanderthal.*
     - b. Superciliaries large. α. Foramen magnum abnormal. *Muskham.*
       - β. Foramen magnum normal?
         - *Sennen, Nether Urquhart.*
         - *Heathery Burn*, "B."
     - c. Superciliaries small.
       - *Plymouth.*
       - *Heathery Burn*, "A."
       - *Blackwater.*
       - *Borris (bed of Nore).*
       - *Engis.*
   - B. Forehead moderately developed.
     - a. Superciliaries small.
       - *Mewslade.*
       - *Eastham.*
       - *Leicester.*

2. Brachycephalic.
   a. Superciliaries large.
      Plau.
      Montrose.
   b. Superciliaries small.
      Etruria, O.

CHARLES CARTER BLAKE.

FOSSILS FROM TREFLACH QUARRY.—Dear Sir,—In the bed of shale above the mountain limestone of the Treflach Quarries, I found two fossils which I find figured in Phillips's Manual as *Gryphæa incurva*, Lias foss., and *G. cymbium*, Lower Oolite foss. Can you, or any of your readers, account for it?—Yours truly, H. M. G. WYTHIM, *Whittington, Oswestry, 27th June.*

SHARKS' TEETH AT PANAMA.—The Miocene deposits at Monkey Hill, near Panamá, have afforded to the geological labours of W. Duprée, Esq., M.D., F.R.G.S., three sharks' teeth, as well as various species of fossil shells. The sharks' teeth belong to the *Carcharodon megalodon*, Agass.; *Hemipristis serra*, Agass.; and a species of *Lamna*, or Porbeagle.

The *Carcharodon* teeth are rather smaller than the average of English specimens from the Red Crag; the *Hemipristis* are in no way distinct from the remains which are found in the "molasse" of Switzerland, Piedmont, and Germany.

I have not identified the *Lamna* with any known species. In the breadth of its base it differs from any tooth I have seen, and the section accords with none of those in the British Museum, or in Agassiz' 'Poissons Fossiles.'

The specific name of *eurybathrodon*, from εὐρὺς, *broad*, and βαθρὸν, *base*, might be proposed, but it would be very injudicious to found a species on one solitary tooth. It is apparently the second tooth in the under jaw, and the teeth which were associated with it in the same jaw might be identified with those of known fossil species. The specimens are now deposited in the British Museum.—CHARLES CARTER BLAKE.

BITUMINOUS SANDSTONE.—A bituminous sandstone, (of which a specimen has been transmitted to the Editor) has been found in sinking a shaft in an ironstone pit near Hogganfield, 3 miles eastward from Glasgow. It occurs at the depth of about 50 fathoms, and is 3 feet in thickness; being overlaid by successive bituminous shales, thin sandstone beds, limestones, etc.

The limestone (Lower Carboniferous) containing *Spirifera bisulcata*, and other fossils, is indurated to an extent equal to compact greenstone; the shales have lost their schistose character, being quite friable or in a state of dry clay, having been deprived more or less of their original colour and assuming the appearance of fire-clays; the sandstone beds are greatly indurated (kingle), and so hard and compact as to approach quartzite of a highly crystalline character, while iron pyrites are diffused through the strata in streaks.

At about 40 fathoms a band of marine fossils occurs, partly in the shale and partly in clay-ironstone nodules accompanying it; these consist of *Actinocrinus crassus* and other crinoids, several species of *Productus* and of *Aviculopecten*,—*A. arenosus*, *A. granosus*, etc.

No trap-dykes or overflows are found in such close proximity as to make one suppose them to be the direct agents in these results, and these effects must have been caused by heated gaseous bodies, or steam, in a similar manner as a thick coal-seam at Cambuslang, near Glasgow, has been found completely coked by the same agency.

What had become of the bituminous and gaseous matter was in doubt till the discovery of this sandstone showed it; its coarse porous character facilitating the impregnation. When under red heat in a crucible it flamed, losing 20 per cent. of weight; but remaining compact, and becoming quite white. A professional chemist in Glasgow reports it as yielding only five gallons of oil to the ton, it therefore probably contains other volatile matter of a light and gaseous description.

This rock would not pay for the working under twenty gallons per ton; and from the greater difficulty of extraction from sandstone, a bituminous shale, such as the Torbane mineral, though it only yielded twenty gallons to the ton, would be equal in value to sandstone giving upwards of thirty.

A similar bituminous rock has been found in two other localities, within about two miles of this; one of these is in a less stratified state, the mineral tar oozing from it, of a black colour, the other is a hard "kingle," of a brown colour, in close proximity to splint or hard coal, from 50 to 60 fathoms down.—W. R. S., Glasgow.

HUMAN REMAINS IN ALLUVIUM.—The alluvium of the Kennet is a well-marked deposit, and forms large and valuable water-meadows. Dr. Buckland, who records human remains in it, says it is "much mixed with minute crystals of selenite and a small quantity of carbonate of lime, and abounds with the bones and horns of oxen, red-deer, roebucks, horses, wild boars, and beavers. A *human skull*, of high antiquity, has also been found in it, at a depth of many feet, at the contact of the peat with a substratum of shell-marl. It was accompanied by rude instruments of stone.* Along the northern edge of this peat-bog, there is a considerable deposit of marl, mixed with calcareous tufa . . . from two to ten feet in thickness, and frequently interstratified with beds of peat, varying from six inches to three or four feet in thickness." In the neighbourhood of Newbury the lower marl contains mammalian remains, which are said to be more plentiful towards the edge of the valley. The list of these comprises:—*Bos primigenius*, *B. longifrons*, *Cervus capreolus*, *C. elaphus*, *Equus*, *Sus scrofa*, *Canis lupus*, *Lutra vulgaris*, *Ursus spelæus*, *Castor Europæus*, *Arvicola* (water-rat). The peat is dug in places for fuel, and, with shell-marl, but not for manure: in it are found remains of oak, alder, willow, fir, birch, hazel, and of mosses, reeds, and equiseta.

FOREIGN INTELLIGENCE.

In a former number of the 'Geologist' (vol. v. p. 74) the discovery of the presence of rubidium and cæsium in the mica of Zinnwald, Bohemia, was mentioned. Since then, M. E. Seybel, in his extensive chemical manufactory at Liesing, having submitted 800 lbs. of this mica to chemical treatment, has obtained from it carbonate of lithium, and above 5 ounces of the chlorurets of rubidium and cæsium. This Zinnwald mica, containing these metals in larger proportions than any other substance at present known (nearly 3 per cent.), may prove particularly adapted for the

* See Dr. Buckland's paper, Geol. Transact., 2nd series, vol. ii., p. 120; Rupert Jones's 'Lecture on the Geology of Newbury,' 1854; and 'Memoirs of the Geological Survey: Explanation of Sheet 12,' by Messrs. Bristow and Whitaker, 1862.

preparation of considerable quantities of these peculiar substances, if submitted to proper chemico-technical manipulation.*

Professor Schneider has noted the presence of formic acid, which is of extremely rare occurrence in mineral waters, in two of the springs at Carlsbrunn in Austrian Silesia. These belong to the numerous group of ferruginous acidulated springs, with alkaline and earthy salts, scattered throughout the Sudetian mountains. Their temperature is not above 6° 5 to 7° 0 C.; they are nearly saturated with carbonic acid, and contain 7·04 parts of solid substances (Carbonate of Iron, 0·286 per cent.; Carb. Lime, 5 053; Carb. Magnesia, 0·875; together with very minute proportions of alkaline salts) in 10.000 parts of water.†

M. Bulliot, the President of the *Société Eduenne*, states the probable existence, in the lac of Ambléon, in the mountainous district of the Rhone between Belley and Lhuis, of ancient remains like those of the Swiss Lakes. This district, until a few years since, was all but inaccessible, and is now traversed only by a narrow road across the precipices. The lake is little more than a mile in circumference, but its elevation is not less than 2000 feet above the level of the sea; while still higher above it towers the mountain of Innimond. Under the water may be clearly seen portions of fir-trees; some erect, others crosswise, and apparently forming a platform. The people of the district, when the water is low, fasten ropes to these timbers and draw them out with their oxen for use. It is remarkable that they consist entirely of pine, a tree which no longer exists on the mountain; some of the timbers are placed at least a yard apart, and have a diameter of 8 to 10 inches. Whether these are the remains of a forest, or of lacustrine dwellings, only actual excavations can determine. It is said that there are similar remains in other lakes in the district.

REVIEWS.

On the Zoology of Ancient Europe. By A. Newton, M.A. London: Macmillan, 1862.

This is a report, in pamphlet form, of a lecture given in the spring of the present year, before the Cambridge Philosophical Society. It is discursive, but pleasant, and full of excellent material and remarks.

The subject is one of great interest, but which its title scarcely expresses, as it in no way designates the age—that immediate one between the geological and historical—to which the author chiefly restricts his remarks. The notices of the geographical ranges of Carnivora, of the Swiss Lake dwellings, and the Danish Kjökkenmöddings are very good; but perhaps the part that will be most attractive to our readers will be the account of relics found in the meres of Norfolk, of probably similar pile-houses to those of the Swiss lakes, although on a small scale.

A few miles from Thetford, are a number of natural ponds, or meres, varying in size, from twenty roods to fifty acres. Many of these are situated in the parishes of East and West Wretham, and one of them, known as

* Proceedings Imper. Acad. Vienna, March 29, 1862. Communicated by Count Marschall.

† Proceedings Imper. Acad. Vienna, April 3, 1862. Communicated by Count Marschall.

the West Mere, five or six acres in extent, was drained of the waters in 1851, by the proprietor, Mr. Birch, of Wretham Hall.

In this mere there was ordinarily about four feet of water, and beneath it about eight feet of soft black mud, partly held in suspension, and requiring to be removed in scoops. When this mud was being cleared out, a great number of bones were discovered, chiefly deposited, as from its semi-liquid nature might have been expected, at the bottom. They were nearly all those of the red deer (*Cervus elaphus*), and of the now extinct long-faced ox (*Bos longifrons*).

Near the centre of the mere, lying below the black mud, was found a ring, or circular bank, of fine white earth, outside of which, the bottom of the mere was so soft and deep as to be impassable. This ring, or bank, was about twenty or thirty feet across, a foot wide, and about four feet in height, and near its inner circumference a deep hole, or well, was marked out by a circle of stout stakes. There was also, near by, the remains of a flint wall and traces of a rude ladder.

The deer's antlers and other bones had many of them cut-marks of rude tools. Many flint-disks, seemingly resembling what the Danish antiquaries call sling-stones, are said to have been found in this and other meres, but none of them have been preserved.

A few years later, 1856, the largest of these meres, having an area of forty-eight acres, was emptied and cleaned out, and during the operation was visited by Sir Charles Bunbury, who has recorded his observations in the Geological Society's Journal (vol. xii.). Sir Charles incidentally states the presence of numerous posts of oak-wood, shaped and pointed by human art, standing erect in the mud.

M. Troyon, in his 'Habitations Lacustres,' recognizes the similarity of these Norfolk antiquities to the Pile-buildings of his own country.

These few remarks are sufficient to show the interest this pamphlet possesses.

Proceedings of Geologists' Association, No. 8.

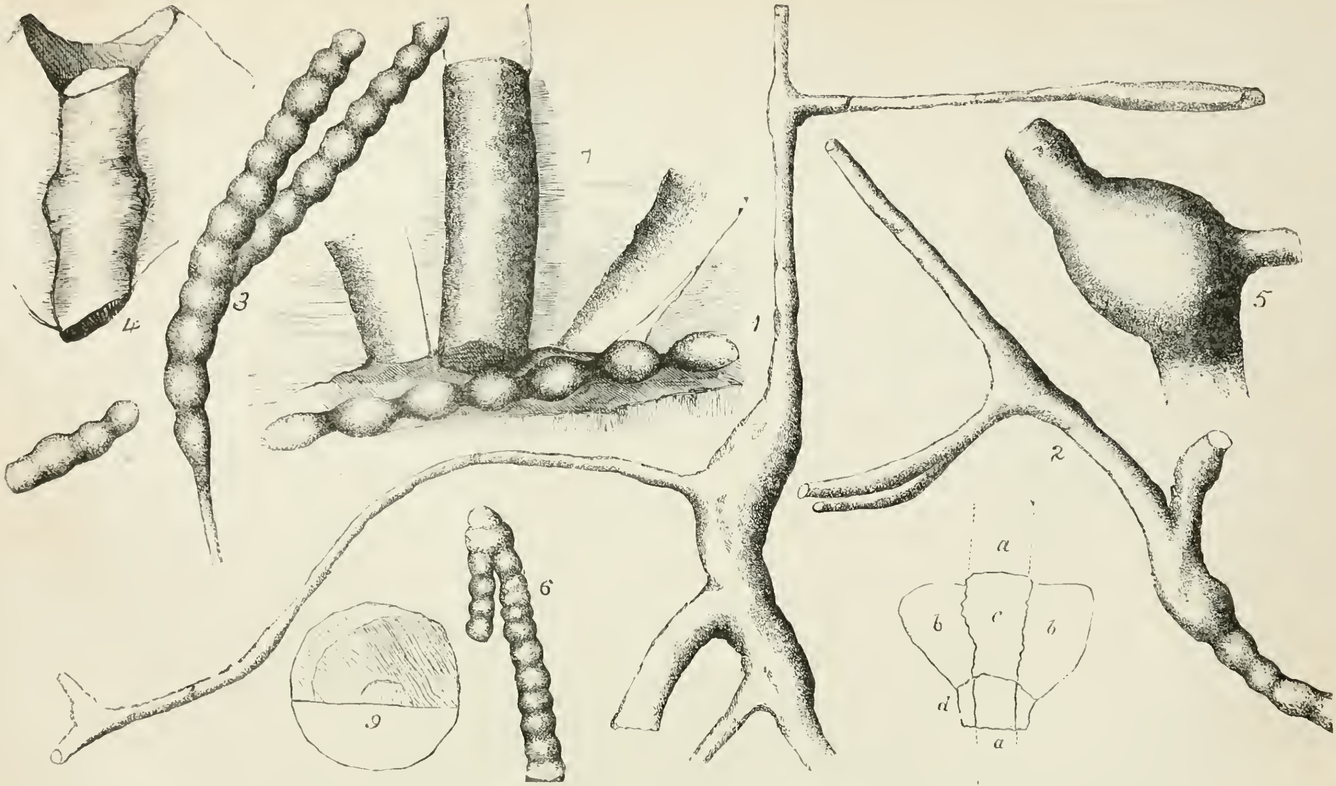
This is a thick part of some eighty pages, got up in better manner and under better editorship than any number we have yet seen. It contains moreover some good papers, while the additional lists of new members show that the Association is making headway.

We wish it well. We have always done so; and if we have sometimes sounded a note of warning or condemnation, there has been no more malice or illwill in it than in the paternal advice of a father to his son. It was through this journal the Association had birth, and it is not likely therefore but that we should ever feel the liveliest interest in it. We do not think, however, it has yet settled down to its proper work. From its geographical locality, and by its inherent construction, it is destined sooner or later to become the Metropolitan Field Club. The district round London is a wide and uncultivated field. Strange as this statement may seem yet it is true, and it will be far better for the Geologists' Association to organize themselves for this work than to be merely content with simple day's pleasurings in some far-distant towns. No doubt a great deal of good is to be got from looking at the blue flat shore of gault at Folkestone, or picking up hamper-loads of phosphate-nodules at Cambridge, and a trip to the Malverns would be an admirable occasion for a delightful picnic; but no good work is done for our science by these desultory excursions. Let the Association, however, take the Ordnance maps, and construct a geological map of the London area; let them make sections across the London Basin from east to west, from north to south: let them take the elevations of the Drift-beds and collect the fossils from the valley-gravels, and what a fund of valuable material in a short time they would get together! Excursions to places round London might be made weekly, and then occasionally they could journey further afield to compare what they had done in their own area with what was to be seen and learnt in another. They would thus be doing good service, and every individual member so engaged would be fitting himself for an active fellowship of the Geological Society, or for carrying on scientific work in foreign lands.

These remarks have been forced upon us by the desultory character of the number before us. First, we have a paper "On Coal," by Professor Morris; and an admirable paper it is, although in some points we differ as to conclusions, as our expressed opinions will have led its readers to perceive. Then, "On the Crag of Yarmouth," by Mr. Rose; "On the Hempstead Beds of the Isle of Wight," by Dr. Wilkins; "On the Exchange of Fossils among the Members," by Mr. Bott; "On Gold from Nova Scotia," by Mr. Tennant: "On Preparing Peat for Fuel and Gas-making," by Mr. Rickard; "On Lime and Limestone," by Professor Tennant; "On Ancient Flint Implements of Yorkshire and the Modern Fabrication of similar Specimens," by the Rev. Mr. Wiltshire; "On the Cretaceous Rocks of Norfolk," by Mr. Rose; "On the Plasticity and Odour of Clay," by Mr. Tomlinson. Now, can any one glance over this list, and not see the desultory nature of the work doing by the Association? Is there any purpose or end to be traced in this heterogeneous collection of subjects? Mr. Clarke got very much laughed at, at the commencement of the institution, for proposing an organized survey of the whole British kingdom; but even it would be better to attempt *that* than to attempt nothing at all.

It rests, however, with the Committee, to form a plan for working the members together. Let them try, and they will find plenty of the members active enough and ready enough for work to respond to their call. London is the birthplace of the Geologists' Association, and the London area must become sooner or later the scene of their labours and triumphs, or in the end the Society will pass away like a breath of the summer's wind and leave no imprint of its passage behind. Look at the drainage works and the subterranean railway. See what miles of earth they have exposed to the light of day; and who, save Mr. Cresy and Mr. Lovick on the actual staff of the Board of Works, Mr. Evans, Mr. Edmund Jones, and one or two other amateurs, have ever given even a passing glance at these gigantic explorations? No doubt we shall be asked, as we have been before on the occasions of our former strictures, why we are so hard upon the Association, and perhaps something like malice may be again imputed to us. We do not, however, mean mischief in any way. We speak in the sincerest friendship, and with the utmost goodwill towards the Association; but we have no other means of speaking. We hold no seat at the Council Board; we take no active part in the management of the Society; but we have seen the good the Society derives from the frankness of our criticisms and our unmistakable suggestions. As an example, we need only point to one case—the provincial excursions, the arrangements for which followed close on our remarks. Let no one be misled as to our intentions in commenting on the doings of the Association; we wish to advance its welfare and permanence.

The members have, in Professor Tennant, an active President, who loses no opportunity of bringing their matters before those who can bring them under public notice, and these will be ready enough to bring the Association into prominence whenever the Society deserves it. When we introduce a friend into society, we like him to be somebody of whom we may well feel proud. The best reason for pride must be good deeds done.



VARIOUS PORTIONS OF SIPHONIA BENSTEDII, FROM DIFFERENT SPECIMENS.

THE GEOLOGIST.

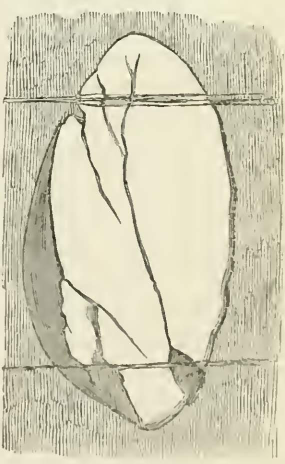
SEPTEMBER 1862.

SUPPOSED IMPRINTS IN THE LOWER CAMBRIAN BEDS OF THE ISLE OF MAN.

By John Taylor, Esq.

Member of Council of Manchester Geological Society, etc.

The good example which has been set us by Mr. Salter to look out for traces of mechanical and vital agencies in the Cambrian beds is worthy to be followed by every brother of the hammer; and instead of waiting, like Micawber, for "something to turn up," to set heartily to work and turn up the stones for ourselves. It is well known what good work Mr. Salter has done in the Cambrians of the Longmynd, towards clearing up the circumstances under which those rocks were deposited, as well as in tracing the remains of their ancient life; but much remains to be done ere this formation is as well known as the others. One thing, however, is certain, that the Cambrians and the Drift are at present the "lions" of the geological world, so that the study need not suffer on the ground of unpopularity.



Supposed footprint at Dalby, Isle of Man. ¼ nat. size.

Being out one day (during a recent visit to the Isle of Man), at Dalby, where the Cambrian rocks are quarried for flags by a newly-formed slate-company, I observed that many of the slabs were most decidedly ripple-marked. This is, I believe, the first time that such appearances have been observed in the island; indeed, with the exception of some doubtful fucoids, no fossils have been met with in these beds. The ripple-marks, however, in this instance, were so distinct, that no doubt remained in my mind as to their shallow-water deposition. The same feature also led me more carefully to look out for other signs of littoral deposits, in the shape of worm-tracks, sun-cracks, or rain-prints. Judge then my surprise—and, need I say, delight?—upon observing the impression of what I believe to be footprints upon a layer of rock immediately below the ripple-marked bed. There were three such imprints visible, each being about six or eight inches out of the straight line, and alternately on each side. The impressions are about two feet six inches apart, and seemed all to have been formed by the same agency. The most distinct of them was broken just at the end, and a transverse section of the imprint shows it to be lenticular, or, in other words, that the present surface-appearance is not the original one, but is caused by the filling up of the indentation. The outline of each print is remarkably distinct, and even where the surface-matter has fallen off the line is well preserved. The *tout ensemble* is very much like the dotted outline of the *Protichnites* figured in Owen's Palæontology, and which have been found in the Potsdam Sandstone of Canada, and more recently in Lower Silurian rocks in Scotland. What seems to bear out the fact that these *are* footprints, is that the quarrymen remarked they had frequently met with them. I have briefly mentioned this fact, intending at some future period to take up the subject again when my data are more numerous.

The position of the beds containing the supposed footprints is towards the top of the Manx Cambrians; and near the place where I obtained the slab which contains them, a fault occurs, which is beautifully seen from the sea. This has thrown the layers up into an almost perpendicular position on the right-hand side, whilst the others on the left abut against them, something after the manner in which the books on a shelf recline against the end ones when intervening ones have been taken away.

It is in the perpendicular beds, a few yards away from the fault, that the impressions are met with, along with the ripple-marks.

The slabs are quarried in great lengths, and are very equal in thickness. Close to the bed containing the impressions there are often intercalated layers of slate, quarried for roofing purposes. The thickness of the slabs is from three to six inches.

[We have given our correspondent's communication the place of honour, because if it be worth anything at all, it is worthy of the utmost prominence. We add, however, a word of caution, for we cannot append our own testimony to Mr. Taylor's opinion. On receiving the communication, we immediately wrote to Mr. Taylor for the specimens, which he has obligingly sent us, but, unfortunately, we are no wiser than before. The impressions, or whatever they may be, to our eyes, look more like portions of gigantic Lingulæ, or some fibrous shell, than like footprints. If however they occur alternately on each side of a direct line, as stated by Mr. Taylor, that fact is very singular. We would willingly have devoted a plate to them had there been any utility in so doing, but although our artistic powers are tolerably good, as our readers know, we have much doubt whether we could render them either pictorially or sufficiently intelligibly to be of any practical value. Mr. Salter, to whom we sent an outline of one impression, says they are not organic at all, and adds that we cannot possibly say whether the beds be Cambrian until they have been properly surveyed. We differ from him as to their organic origin. We consider there is little doubt about that; but *what* they are we are disposed to think it passes the wit of man to say.—Ed. Geol.]

PAST LIFE IN SOUTH AMERICA.

By Charles Carter Blake, Esq.,

Lecturer on Zoology at the London Institution.

The minds of the British public, accustomed to review the complex phenomena of geology and palæontology in the Old, are apt to neglect the equally interesting evidences afforded to them of past life in the New World. American palæontology is distinguished not because the mighty hemisphere, now the seat of political convulsions, has not passed through analogous phases of life-stages to those presented by the elder continent, nor because the extinct fauna of America is less interesting than that of Europe, Asia, or Australia, nor that the most eminent men in both worlds have omitted to call attention to the stupendous monuments of bygone existence in the pampas of La Plata or on the shores of Patagonia, but because the public mind has not yet sufficiently realized the idea that during the period whilst Europe and Asia underwent the manifold and changing influences of geological time, like conditions were passed through in America.

A tradition exists in the minds of all the earliest aboriginal nations of America, on the banks of the Missouri, at Manta, at Punta St. Elena in Ecuador, at Suacha in New Granada, at Tarija on the eastern slopes of the Andes, and at Tagua-tagua in the south of Chile, that a vast nation of colossal human beings existed before the present inhabitants. These giants, the credulous and imaginative mind of the native supposed, were destroyed by the deities, like the old race of Titans by the Olympian gods, or the Hrimthursar—the frost-giants of ice and snow—by the supporters of Odin and the Æsir in the Norse mythology. It is instructive to trace these unhistorical narratives back to their physical origin; it is suggestive to find that such origin is rational, and does not rest upon any purely mythical base. Such a colossal race of beings did exist in the old times; they were, however, the gigantic mastodons, etc., which man drove before him and exterminated. When M. Albert Koch, in the year 1842, brought the so-called "*Missourium*" skeleton to England, which afterwards was demonstrated to be identical with the *Mastodon Ohioticus*, and now forms a conspicuous object in the British Museum, amongst many other dubious anecdotes recounted by him, was one, that with the bones of *Mastodon* had been found an arrowhead, proving apparently the existence of mankind in America contemporaneous with this great elephantine animal. This marvellous "Yankee cram" was ridiculed by English geologists in 1842 as quite preposterous. Now, however, in 1862, we look at the subject with more cautious and less sceptical eyes. We know that both in France and England, mankind either lived so far ago as the period when the hair-clad elephants and rhinoceroses existed in Normandy and Gascony, or (which is nearly the same thing) the elephants and rhinoceroses lived down to the period when human life, in a state of barbarism, existed in Europe. It is not more preposterous to believe that man, at one time, hunted elephants in the Confederate States than to believe that he hunted rhinoceroses in Normandy, and was himself the prey of hyænas in Devonshire. At all the places where a tradition like this exists in America, evidence of the existence of a fossil *Mastodon* has been found.

In Brazil, proof has been afforded us of the existence of a tradition amongst the Indians of a large ape, termed by them Cayporé, which is the analogue of the gorilla and chimpanzees of Africa. As no man-like ape of any sort exists in South America at the present time, two theories may be suggested to account for this popular belief The negro slaves may have carried their faith in the existence of a huge ape from Sierra Leone and the Gaboon to Brazil, in the same manner as we recognize still amongst the half-Christianized slaves of America the traces of the Obeah-worship of their African forefathers. But the answer to this assumption is, that the tradition in question does not exist in the negro, but in the Indian mind. None of the Indians, however, have actually seen a Cayporé, or rather none of those Indians who profess to have seen them have undergone satisfactorily the ordeal of interrogation by such painstaking observers as Dr. Lund.

A signification is afforded us of the meaning of this tradition when we learn that a colossal ape, approaching in size the human stature, once existed in Brazil, and that it was probably contemporaneous with the early human races. The *Protopithecus Brasiliensis* was four feet high, surpassing far the dimensions of any existing American monkey; it nevertheless was a true platyrrhine, like all the simian forms of the New World. Found in the later Pliocene, the possibility of its being contemporaneous with early man is rendered more probable when we reflect that on the borders of Lake Lagoa Santa, and at Minas Geraes, human remains have been found, coupled with those of forty-four extinct animals, amongst which was another large fossil ape, *Callithrix primævus*.

The extinct elephants and horses of America afford an interesting source of contemplation to the reflective palæontologist. Existing elephants, as is well known, are but of three species, those of Africa, India, and Sumatra. Professor Owen has, however, pointed out that our knowledge has been expanded by fossil evidences, and that during the Pliocene period, elephants existed in Africa, India, Europe, China, and Australia. Thus far there was little to surprise the practical observer, who was accustomed to find a wider distribution of animal life in the later Tertiary times than in the present day. But when we learn that two species of elephant (*Elephas primigenius* and *Texianus*) and one species of *Mastodon* co-existed with each other, in warm, temperate, and cold latitudes in North America, and that two other so-called species of elephantine animal (*Mastodon Andium* and *M. Humboldtii*) browsed on the trees of South America, prior to the upheaval of the vast Andian chain of mountains, astonishment almost verges into incredulity. "Well," it may be said, "since we have thus evidence of American elephants, why may we not have evidence of American rhinoceroses?" We have such proof of an animal closely allied to the rhinoceros and palæothere, discovered by Mr. Darwin in Patagonia, and which at the same time bears some points of analogy, but not of affinity, with the llamas. This animal, the *Macrauchenia*, has also been found on the eastern slopes of the Andes at Tarija, and in the very heart of the Aymará country at Corocoro. Imagination can scarcely conceive the period when this bulky brute, with its long stiff neck, elevated straight upright, as in the guanaco, contested the pastures of Patagonia and Bolivia with the llamas and horses around it. Some reader will say, "I understood that horses were first introduced on the American continent by the followers of Columbus, and that when the aboriginal Americans first viewed the mounted Spaniards, they regarded them as centaur-like monsters, or almost as divinities." The horse, however, of various species, had existed in the New World for countless centuries prior to the advent of the Spanish conquerors: whether its extinction dated previous to the human era is yet undemonstrated; tradition even of its existence had passed away long before the Columbian epoch. Various species of these early American horses are known to us; one from the Confederate States * of North America; another from Bolivia; a third from Chile; and a fourth from Patagonia. The last species (*Equus curvidens*), the best known, because the first discovered, indicates a

* An argument for the scientific recognition of the Confederate States might be founded upon the fact that their flora and fauna differ essentially from those of their more northern antagonists in the less fertile country north of the Ohio. The term "fauna of the United States" conveys no idea to the scientific mind. The term, to use Dr. Latham's expression, "means so much as to mean nothing."

species differing only from the European horse in the greater curvature of the molar teeth. These horses no doubt existed in herds, like the quaggas of South Africa, or like the wild asses of Central Asia. The same influences which promote the numerical increase of horses in South America at the present day, would have tended to promote a similar increase of the equine race in South America during the Pliocene period. The horse was first introduced in A.D. 1537, at Buenos Ayres; forty-three years afterwards, in A.D. 1580, they were found at the Straits of Magellan. The cause why the horse, once numerous in America, became extinct centuries before the time of Columbus, at present baffles speculation. More significant is the fact, that we find in the Old World a three-toed fossil horse (*Hipparion*) which by its annectant affinities to the earlier odd-toed herbivores, has been supposed to be absolutely the ancestor of the present *Equus caballus*. In the New World, however, no such form exists. Whence, then, on a derivative hypothesis, the horses of America?

Two tapirs are found, the one in the North, the other in South America; a dubious tapirine form has also been found at St. Louis, in Missouri, associated with fossils "of unquestionable Secondary date!" Pomel has erected this very suspicious type into a new genus, termed by him *Menodus*. It is not surprising that we should find tapirine forms in South America, when we reflect that the existing tapir, or d'anta, is found over the whole Brazilian and Argentine Confederation, and from Guatemala to Patagonia. In the Panamá and Chiriquí countries, the woolly tapir of the Andes, or Pinchaqué,* also exists, a species far more nearly allied to the extinct races than the other American or than the Sumatran tapir. In the Andes of South America, above the line of 6000 feet, the existing tapir is not found.

When Castelnau was at Tarija, surrounded by fossil remains of mastodons, horses, macrauchenes, scelidotheres, llamas, and other mammalia, he was struck with the state of "fat, contented ignorance" in which the good Franciscan monks had arrived in geological knowledge. The remains which he saw were all, according to them, proofs of the existence of a gigantic race of men who existed prior to the deluge. Padre Osorio, a Jesuit of Paraguay, had declared, in 1638, that he had seen with his own eyes, in the Gran Chaco, a race of men of the highest physical and mental cultivation so tall that the Jesuit with his upraised arms could scarcely touch their heads. Peradventure, these races belonged to the same stock with those Indians of California, immortalized by Padre Fray Pedro Simon, who had ears so large that they served for canopies, and under each of them five or six men could find ample shelter; or they might be allied to those of a neighbouring province, who, when in need of repose, used to go to sleep beneath the waters of a lake on the banks of which they lived. Even the giants whom Osorio imagined, how-

* Last summer, specimens of this species, which is hitherto unrepresented in our National Museum, were to be sold in the streets of Panamá for a dime = 6*d*. English.

ever, were far too small to have produced the mastodon bones of Tarija. When this argument was pressed on the monks, they replied, "that the bones had swelled since they were buried in the earth." Castelnau naïvely remarks, that a like proof might demonstrate that the mastodon bones of Tarija might have belonged to dwarfs. This singular superstition is by no means confined to the monks. Don Francisco Antonio Casello gravely tells his readers, that "the soil of the town of Tarija possesses the virtue of making bones grow beyond measure. If a body of ordinary size is buried, and is disinterred after the lapse of some time, we find the bones excessively swollen." The English reader who scoffs at this ridiculous theory of the Tarijans may, however, recollect that, in the year 1862, there are still a few writers in England who speak of "an unknown mysterious force" which has kept the species of animals distinct from each other throughout all time. We are not yet so far removed from the trammels of an adherence to unproven and undemonstrable assumptions in science to entitle us to ridicule the hypotheses which our less-gifted friends in Bolivia may suggest to the world.

The genus *Antilope* at present is chiefly confined to the Old World. Forty-seven species are found in the Old World, and one, or perhaps a second, in North America. In Brazil, during the Pliocene period, a species (*Antilope maquinensis*) has been discovered by Lund, besides two individuals of the extinct genus *Leptotherium*, allied to *Cervus*. The latitude of Brazil was as well qualified to support antelopes as that of Africa or India, although, since the Pliocene period, their place has been taken by the numerous species of small stags, the Guazútis and Brocket deer of Brazil, Colombia, and Mexico.

The European dog, like the horse, was introduced into America by the followers of Columbus. Prior, however, to this time, there existed in Mexico a small lapdog, termed Alco by the Peruvians, and a mute silky-haired breed employed by the natives of Santo Domingo in the chace. These last were termed Goschis, or Gasque, which word seems, according to Hamilton Smith, to be corrupted from Guarachay, and indicates that these animals were imported by the Caribs from Tierra Firme. Besides these, various species of true wolves, prairie wolves, aguára wolves, aguára dogs, and aguára foxes, being fourteen species in all, are described by Colonel Smith. In Santo Domingo, and on the Pampas of South America, feral dogs are found, the offspring of the European races. The origin of the dogs of Nootka Sound, of the Mackenzie River, and of the Esquimaux, is yet undemonstrated. In Brazil, during the Pliocene period, three species of dog existed.

Mr. Waterhouse has pointed out that the existing mice of the New World all belong to a different genus (*Hesperomys*) to those of the Old. Many species of fossil mice of the same natural group as the other American mice are found in Brazil, where their bones whiten the floor of the caves and fissures where they have been dropped by the owls, who then, as now, preyed upon the diminutive rodents and insectivores. The portions of the skeleton found fossil are exactly those parts which the owl cannot digest, and which she casts out of her mouth as innutritive or indigestible. A coypú of superior size to the existing species is found in the Pliocene strata of Brazil. Many species of small pacas, agútis, and capybáras then existed, allied to those which now infest the banks of the tributaries of the Amazon and Essequibo.

Blood-sucking bats then, as now, found a source of aliment in the warm-blooded mammalia. Cats, the size of the jaguar, subsisted on the numerous herbivorous animals. One of them deserves especial mention. The existing cheetah (*Cynailurus jubatus*) is confined to the Old World, where alone this "hunting-leopard," with non-retractile claws, preys upon the antelopes and deer. It is a surprising fact that a very small species of this hunting-leopard (*Cynailurus minutus*) existed during the Pliocene period in Brazil, with the gigantic *Machairodus*, or sabre-toothed tiger, and the Buenos Ayres bear. This *Machairodus*, the most carnassial of all the predatory animals known to zoologists, existed in the cave breccias of Devonshire, in the Sewálik (tertiary) strata of India, in the mountains of Auvergne and Darmstadt, and in the Patagonian and Brazilian bone caves.

In Chile the progress of geology is small. The erudite and painstaking M. Claudio Gay, who was appointed by the Chileno Government to report on the physical productions of their republic, actually, when describing the Plesiosaurian bones from Concepcion,* spoke of them as being contemporaneous with the Mastodons of Taguatagua, and like them, destroyed by the diluvial catastrophe. These *Plesiosauri* existed at Concepcion during the Jurassic period, and their remains singularly resemble those of some of the same genus from the chalk in England. The same observations may apply to the Ammonites, of which characteristic species are found in the "Oxfordian" and "Liassic" strata of Peru and Chile.

Thus far we have recounted some of the leading features of South American Palæontology. The exigencies of space, however, necessitate a brief glance only at the remains of the hosts of *Toxodontia* and smooth-brained *Bruta* which peopled the forests of Paraguay, the Pampas, and Patagonia. The labours of Mr. Charles Darwin, one of the few philosophical travellers who have ever visited South America, have made the forms of the Megatherium, the Mylodon, and the Glyptodon familiar to us; and the idea of South American Palæontology naturally recalls to the mind of the reader the bulky forms of these huge beasts. The armadillos and sloths of Brazil now form the puny representatives of these bygone creations. The *Mylodon*, which, poised on its hinder limbs, and supported by its powerful tail, tripod-like, with long-continued rapid and energetic vibrations, tore down the most gigantic trees; the *Glyptodon*, whose circular mailed cuirass suggested the idea to its first discoverers, that they had found a buried hogshead in the sand; the *Toxodon*, with its strange interblending of characters, allied to the rhinoceros and the manatee, yet resembling

* Geologist, vol. v. p. 110.

strongly a magnified guinea-pig, all these past forms are enshrined in our Museums, or by their restorations ornament our Crystal Palace. The object of the present paper is not again to describe those animals which the acumen and critical skill of Professor Owen, or the sagacity and hardy research of Mr. Darwin, have unveiled to us. South American Palæontology may well be proud that such labourers as these exist to illustrate its phases, or to demonstrate its signification. Whilst, however, since the publication of the works of these *Dii majores* of science, "evidence has been creeping in" indicative of the existence of new and interesting forms of extinct life in South America, a rapid glance at some of which has been the object of the preceding paper.

The following list is founded on that of Gervais ('Zoologie et Paléontologie Françaises'), but is only intended to offer a sketch of the principal South American Mammalia. Many of the species entered in this list, will doubtless sink to the rank of mere synonyms; whilst under one name, often many natural species will be comprised. In the meanwhile, it will be found useful as indicating the imperfect state of our present knowledge, which is caused by the fact that large districts of South America are yet unexplored by the palæontologist or the fossil collector. The malevolent influences, which retard the progress of physical science in countries colonized by Spaniards or their descendants, have been well described by the late Mr. Buckle, in the second volume of his 'History of Civilization.'

LIST OF FOSSIL MAMMALIA OF SOUTH AMERICA.*

Cebus macrognathus.
Callithrix primævus.
Protopithecus antiquus = Brasiliensis, *Lund.*
Jacchus grandis.
Ursus Bonariensis, *Gerv.*
Canis protalopex.
C. incertus.
C. troglodytes, *Lund.*
Machairodus neogæus, *Owen, Lund sp.*
Felis protopanther.
Felis exilis.
Cynailurus minutus.
Antilope Maquinensis.
Leptotherium majus, *Lund.*
L. minus, *Lund.*
Cervus.
Auchenia (2 *sp.*), *Lund.*
Dicotyles (*pl. sp.*).
Tapirus suinus.
Macrauchenia Patagonica, *Owen*: ? M. Boliviensis, *Huxley.*
Equus neogæus.
E. Americanus (of Chile, a different species from that of North America, to which the same name has been given).
E. curvidens.
Mastodon Andium, *Cuv.* } ? same spec. C. C. B.
M. Humboldtii, *Cuv.* }
Toxodon platensis, *Owen.*
T. angustidens.
Nesodon imbricatus, *Owen.*
O. orinus, *Owen.*
N. Sullivani, *Owen.*
Phyllostoma, *v. sp.*
Dysopes Temminckii.
Mus, *v. sp.*
Ctenomys antiquus, *v.* priscus.
C. Bonariensis.
Phyllomys Brasiliensis.
Nelomys antricola.
Lonchophorus fossilis, *Lund.*
Loncheres elegans.
Aulacodon Temminckii?
Myopotamus antiquus, *Lund.*
Synætheres magna.

* Adapted from Gervais, 'Zoologie et Paléontologie Françaises,' 2nd edition, 4to. Paris, 1859.

Synætheres dubia.
Lagostomus Brasiliensis.
Dasyprocta capreolus.
Cœlogenys laticeps.
C. major.
Kerodon antiquum.
K. bilobidens.
Cavia robusta.
C. gracilis.
Hydrochærus sulcidens.
Megamys Patagonensis, D'Orbigny (genus of which the classification is yet doubtful).
Megatherium Cuvieri, *Desm.*
Mylodon robustus, *Owen.*
M. Darwini, *Owen.*
M. Harlani, *Owen.*
Megalonyx Kaupii: ? Gnathopsis Oweni, *Leidy.*
M. Maquinensis.
Scelidotherium leptocephalum, *Owen.*
S. Cuvieri, *Owen.*
S. Bucklandi, *Owen.*
S. minutum: ? S. Brongniarti, *Lund.*
Cœlodon Maquinense, *Lund.*
Sphænodon minutus, *Lund. sp.*
Glyptodon clavipes, *Owen.*
G. reticulatus, *Owen.*
G. tuberculatus = Schistopleurum typus, S. gemmatum and tuberculatum, *Nodot.*
G. ornatus, *Owen.*
G. clavicaudatus, *Owen.*
Hoplophorus euphractus.
H. selloi, *Lund.*
H. minor.
Pachytherium magnum, *Lund.*
Chlamydotherium Humboldtii, *Lund.*
Chlamydotherium *s.* Oenotherium gigas, *Lund.*
Dasypus maximus.
D. antiquus.
D. punctatus.
Euryodon latidens, *Lund.*
Heterodon diversidens, *Lund.*
Glossotherium, *Owen* = Mylodon?
? Abathmodon fossilis, *Lund.*
? Speothos pacivorus, *Lund.*

A VISIT TO RECULVER, IN KENT.

By George D. Gibb, M.D., M.A., F.G.S.

Those who are familiar with Sir Charles Lyell's 'Principles of Geology' will remember the illustrations given, in the twentieth chapter of his able and most philosophical book, of the action of the sea on various parts of the coasts of Britain. The changes that have taken place in some parts, even within the historical period, have been very considerable, and perhaps none more so than on the eastern and south-eastern coasts of England, where the encroachments of the sea seem to have been of the most destructive character. From the western coast of the Isle of Sheppey, extending eastwards to Herne Bay, Reculver, and Thanet, the destructive action of both the sea and the other elements has been witnessed by many in our own time; and every year tells its history of a change in some part of this line of coast.

I had long contemplated a visit to Reculver, and in the month of June last the opportunity of seeing this part of the coast was afforded me. No place is more accessible from London than Herne Bay; the visitor has the opportunity of running down either by steamer from London Bridge, or by the London, Chatham, and Dover Railway from either the London Bridge or Victoria stations. If time is an object, the latter is preferable, and it was the route I chose, which enabled me to see and learn all that I desired in a single day.

Leaving London at a quarter-past eight on a fine Sunday morning, in an excursion train, with (as it appeared to myself and others) nearly 1500 people, we made but few stoppages until we reached Faversham, at half-past ten, where those who were going on to Herne Bay had to change carriages. As the next train did not leave for the latter place until ten minutes past eleven, it allowed of time to examine that small but apparently old town. We reached Herne Bay at half-past eleven, stopping at Whitstable on our route. To some persons the journey of three hours and a quarter may appear long, but in reality it is not so, when the distance is considered, enlivened by the number of objects to be seen along the road. The sea is visible for some distance before reaching Herne Bay, and the heights of Sheppey could be very readily distinguished from the south.

The railway station is about half a mile to the south-west of Herne Bay, and the latter seemed to be a larger place than I had anticipated. The pier, which is very long, no doubt marks the boundary of what was once the mainland, washed away by the sea. Immediately opposite the town, the hand of man has provided against further denudation. On arriving at the eastern extremity of the town, the cliffs are reached, here commencing by a gentle ascent. Along their summit I leisurely wended my way to Reculver, some three or four miles distant. A large portion of them had fallen only very lately —indeed, within the past few months, as I was informed; and to some extent I could recognize the deposits as described by Dr. Michell (Proc. Geol. Soc. vol. ii.), *i.e.* in that part of the cliffs situate between Reculver and Herne Bay, about two miles in extent. "The upper part, where the beds are fully developed, consists of about 35 feet of mottled, brown, and red clay; and the lower part of about 50 feet of sand, containing a layer of masses of sandstone. Fossils are stated to be found only in the sand, and to belong chiefly to a species of *Venus*."

It was this high part of the cliff which was now chiefly in ruins from late slips, the result of the great rains in early spring. I could observe too, many large slabs of this sandstone strewed along the beach. About halfway I came to a deep ravine, and although the cliff here was very steep, I managed to descend and cross it without going half a mile round. I did not stop now until I arrived at the old church of Reculver, unless occasionally to gaze at it from a distance, its appearance being long familiar to me from the drawings in Sir Charles Lyell's book. I was certainly amply repaid for my visit; here was before me a good illustration of the wear and tear of the land by the sea, aided by the rains. Years ago I was delighted with the description of this pretty spot, and had often expressed the desire to visit it. Speaking of this place, Sir Charles says, "Still further east stands the church of Reculver, upon a cliff composed of clay and sand, about twenty feet high. Reculver (Regulvium) was an important military station in the time of the Romans, and appears, from Leland's account, to have been, so late as Henry VIII.'s reign, nearly one mile distant from the sea. In the 'Gentleman's Magazine' there is a view of it, taken in 1781, which still represents a considerable space as intervening between the north wall of the churchyard and the cliff. Some time before the year 1780, the waves had reached the site of the ancient Roman camp, or fortification, the walls of which had continued for several years after they were undermined to overhang the sea, being firmly cemented into one mass. They were eighty yards nearer the sea than the church, and they are spoken of in the 'Topographia Britannica,' in the year 1780, as having recently fallen down. In 1804, part of the churchyard with some adjoining houses was washed away, and the ancient church, with its two lofty spires, a well-known landmark, was dismantled and abandoned as a place of worship. It is still standing (1834), but would probably have been annihilated ere this, had not the force of the waves been checked by an artificial causeway of stones and large wooden piles driven into the sands to break the force of the waves."

Let us see how matters now are, in 1862, some twenty-eight years after Sir Charles visited it. The towers of the old church still stand as represented in the picture in Sir Charles's book, but a large portion of the cliff *in front*, fully two-thirds, has fallen down, that especially including the hedges; and the burying-ground is now exposed in a line parallel to the front of the church. Besides the groins and the artificial causeway of stones, to protect this part of the coast, there is an artificial embankment as well, extending to the west of the church. I compared the accompanying reduced copy of a woodcut, made in 1848, of "*Reculver, as it is*," with the ruins, on the spot. It is very correct as to the towers and remains of walls, with the beacons on the former. But the stone fence there represented is wholly gone. So that the chief alteration round Reculver is the loss of a considerable portion of the cliff in front of the church, and the disappearance of the low wall which surrounded the northern aspect of the latter. The wear and tear of the cliff to the westward, no doubt, has been considerable during the last thirty years, and it appears to be gradually stealing upon the contiguous farmland, as is witnessed at Sheppey.

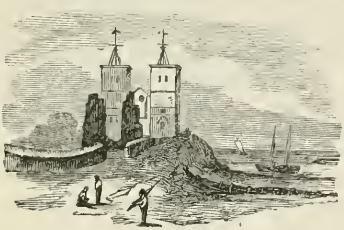


Fig. 1.—View of Reculver, 1848.

I examined the old church in every particular, ascended the old spiral stone staircase in the northern tower to the first floor, thence three distinct ladders which lead to the top, and I stood alongside the beacon. As the wind was very strong, I did not remain long, but enjoyed a magnificent view of things in the distance. I could see Margate in one direction, and Sheppey in the other, and likewise far inland to the southward; whilst to the north and east, the sea was seen covered with boats and vessels as far as the eye could reach. On descending to the first floor again, we passed out of a door leading to a sort of friars' walk, which took us across to the other or southern tower. Numerous holes were seen inside the walls, in which birds had built their nests; some of them contained young, of the starling especially. I picked up in this tower a few human bones from the churchyard, collected by the people who had charge of the place, and brought away with me an axis, a clavicle, and a temporal bone, in the usual condition of graveyard specimens.

I now descended to the ground and visited the Roman encampment, at least the remains of it, walking round as much of the old wall as is visible at its eastern and southern faces. It was still very perfect, although in some places undermined, and portions had fallen outwards in some places. Many fragments of genuine Roman brick were observed, which had been built in by the Romans. Occasionally Roman coins are found about here, generally much defaced and in bad condition. Gold rings and other articles are now and then picked up at the base of the exposed wall of the old graveyard, and not unfrequently the end of a coffin becomes exposed, and its contents are soon rifled with the object of finding jewellery.

As an object of antiquity, the remains of the old church are well worthy of preservation. I lingered about Reculver for some hours, and retraced my steps to Herne Bay. From Reculver, and indeed all along the coast to Herne Bay, the high land of the east end of Sheppey is a prominent object in the distance. Shoeburyness, on the opposite side of the Thames, can also be seen. South of this place is Herne, which gives its name to what once was a bay. Herne Bay has nothing to boast of but the sea and its long pier, the termination of which shows where the line of coast at one time extended, as we may infer from the Admiralty charts of the present day, which I think very accurately indicate the former position and boundaries of the land by the presence of the shoals of clay and sand. The point of attraction about here is certainly Reculver, but the inhabitants do not appear to know it.

About halfway to Reculver, I picked up on the top of the cliff an undoubted flint-implement in a broken condition, but still sufficiently distinct to point out its real nature. It strongly resembles many of those I have seen, both in colour and shape. The latter is shown in the annexed woodcut. It is not the first time that flint-implements have been found at Reculver, as in the 'Geologist' for July they are referred to, in a review of Mr. Evans's paper on 'Further Discoveries of Flint Implements in the Drift.'

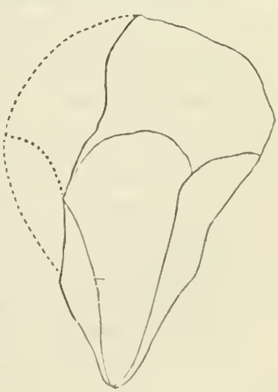


Fig. 2.—Small flint implement.

The train which brought me down to Herne Bay left for London at half-past seven, having allowed me eight hours to wander about a part of the coast, which will amply repay a visit.

THE GEOLOGY OF MAIDSTONE.

By W. H. Bensted, Esq.

(*Continued from page* 301.)

The Kentish Ragstone is a source of very considerable trade to Maidstone, and gives employment to many workmen. Several barges are constantly engaged in conveying to the coasts of Kent and Sussex, in the marshes of which it is very extensively employed for the banks or sea-walls. In Romney Marsh and on the eastern side of the Isle of Sheppey a large expenditure is yearly incurred in thus protecting large and valuable tracts of land from the ravages of the sea. The ragstone is also extensively used as a road-stone and for buildings, large quantities of the stone being sent to London and other places especially for the former purpose. A small quantity is burnt into lime of a very superior quality; but the abundance of chalk in this neighbourhood, and the greater cheapness of that rock, prevents the general use of the stronger but more costly stone-lime.

Many handsome buildings in Maidstone and other places in the county are built of it. Of these in Maidstone may be mentioned the new gaol, the lunatic asylum, and the new church. Of ancient buildings constructed of it are the old parish church of All Saints, the Episcopal Palace and College. Many of the London churches, and nearly all of those on the banks of the Thames and Medway, have a great proportion of this stone in their walls; and proofs of its durability and early application to building purposes may be seen in the present condition of Allington and Rochester castles, and most of the bridges from Aylesford to Tunbridge.

In removing the pier of the centre arch at Aylesford, the mortar, made of ragstone-lime, had become so hard that blasting by gunpowder was necessary to separate the stones.

In the Iguanodon quarry alone from twenty-five to thirty men are constantly at work. Upon uncovering the stone, the surface and sides are found to be water-worn in an extraordinary manner; the cause of which will be considered when the superficial clay is described. The upper layer is very irregular in thickness, and is of an inferior quality, being porous and cherty, of a spongeous structure, and coloured by oxide of iron. The principal fossil is *Trigonia spinosa*, which occurs in chalcedony. These trigoniæ are frequently met dispersed over the surface-soil, being the relics of beds of stone which have been subjected to destruction. This layer is about 6 to 8 inches thick, and of a concretionary character. A group of three layers of stone follow next; the stone being hard, crystalline, and slightly tinged of a ferruginous colour. The upper layer contains quantities of the stems and lobes of a singular sponge or zoophyte, in

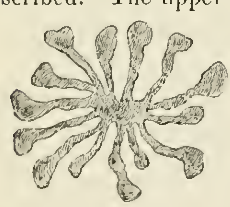


Fig. 7.—Alcyonium (?) from upper beds.

shape and appearance very like an alcyonium. Some of the branches of these fossils radiate from the central mass to a distance of 18 inches (fig. 7), each branch ending with a thick knob, and I have seen as many as twenty or thirty springing from a single stem. In some instances the sponges are prostrate, in others erect, as in fig. 4, plate xix.

It is very rarely that shells are found in the stone of this group; occasionally a detached valve of a terebratula or of an oyster is seen. The associated beds of hassock are very soft, and full of casts of cylindrical stems; the lowermost stone-bed is remarkably cavernous, from the hassock below it being washed away, leaving the siliceous nodules standing out.

In 1846 I discovered in these beds a saurian bone bearing a great resemblance to the tibia of the Iguanodon; but as only one end was preserved, I cannot come to any certain determination of it.

A second group of limestone now follows, of a light colour, and associated with hassock of a very good quality for building-purposes. The first bed is sometimes 3 feet in thickness, and the stone excellent for working up. The hassock ranges from 2 to 3 feet in thickness, and is of a coarse texture. No traces of stem-casts have been met with in this group. One of the most remarkable of the Lower Greensand spongeous organisms is, however, so characteristic of it, that in the course of twenty years' collecting I have not met with this form in any of the other strata. During that period I have collected a large number of specimens, showing a great variety of form and condition, it being only from a very numerous and well-selected series that a true conclusion as to their habits of growth and nature can be drawn. These fossils are, I believe, a species of Siphonia. The accompanying figures (Pl. xvii. and xviii.) give numerous details of the principal and the subsidiary parts. It appears to have had a cylindrical stem, with lobes at intervals in the course of its direction; the lobes bulging out on one side more than on the other, and varying much in size. They are generally rougher or more covered with papillæ than the stem. Four, and even more, of these lobes have been seen on a single stem, the apex or top of which general consists of a nodule of siliceous sand, even when these sponges are embedded in the limestone rock. In the accompanying plate (Pl. xvii.) the head is composed of siliceous sand, the stem and lower lobe of calcareous limestone of similar texture to the surrounding matrix. These conditions were so common, that I was led to examine the structure of the siliceous heads, and found that sponge-spiculæ were much more abundant in them than in the stem and lower lobes, which invariably partake more or less of the properties of the surrounding stone.

These sandy or cherty heads or nodules sometimes contain a continuation of the stem and one of its lobes as a core within them. In some specimens only an ordinary portion of the stem passes through; in others, these siliceous excrescences are permeated by numerous smaller branches ramifying through them. These nodules are full of sponge-spiculæ, which are especially abundant round the stems and lobes, which they cover as a fringe (Pl. xviii. fig. 4); but the stem and lobes below the nodules very rarely display any spiculæ, and often present a smooth surface as if abraded.

In these stone-beds beaded branches often attracted my attention. These consisted of small lobes close to each other, and about the size of common peas (Pl. xviii. fig. 3). I have collected many specimens, and have come to the conclusion that they are parts of these lobed siphoniæ; some of these branches are single, others double or bifurcate—in one instance trifurcate. The beaded portions often proceed from a thin cylindrical stem. The accompanying illustrative figures in Pl. xviii. are—Figs. 1 and 2. Lateral branches of siphonia. Fig. 5. Node of stem of siphonia. Fig. 6. Branches of small lobes with a return, or a furcation. Fig. 7. Beaded branch crossing a stem of siphonia, and two other branches or stems. Fig. 8. Section of a small lobe with stem passing through it. Fig. 9. View of upper surface of the same lobe, covered with what I believe to be spiculæ. As to the conjectured mass of spiculæ in the last figure, I am in doubt whether to consider it as belonging to the siphonia, or whether to attribute the formation of those spiculæ-like objects to crystalline action. Such appearances frequently occur in slabs of stone over spaces of many square inches, seemingly not extending to any depth, but all arranged parallel to each other, and running as a seam through the stone for some distance, and, as far as could be perceived, unconnected in any way with any portions of siphoniæ or other sponges. In a considerable number of specimens I have noticed on the stems and lobes a kind of fringe or border running lengthwise, similar to the ridges left upon the surface of plaster models by the seams in the moulds. These ridges are generally on opposite sides of, and parallel with the stem.

The hassock beds of this group contain some highly interesting remains of fossil plants. In 1839, I discovered an exceedingly interesting specimen of *Dracæna*—the first specimen of this genus met with in the Lower Greensand. It is now in the British Museum, and it has been named by M. König, *Dracæna Benstedii*.*

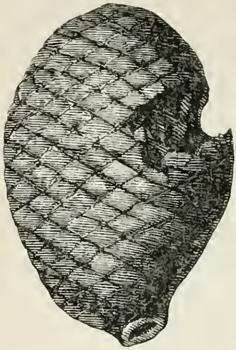
A paper was read before the Geological Society, by Dr. Mantell, in 1843, descriptive of a fossil cone which I discovered in the hassock of this group, and presented by me to that eminent geologist. The following extract from the proceedings of that Society may be conveniently added in this place.

"The vegetable remains from this quarry are referable to the acotyledonous, monocotyledonous, and dictyledonous classes. They consist of *Fucus Targonii*, and some intermediate species of the same genus; of stems, and apparently traces of foliage of endogenous trees allied to *Dracæna*, and trunks and branches of coniferæ.

"The wood occurs both in a calcareous and siliceous state. I have

* Dracæna is a genus of plants of the Order Liliaceæ. Mr. König has neither figured nor described the specimen so far as we know; but the name is taken, in Professor Morris's catalogue, apparently from the Museum tablet attached to the specimen.—Ed. Geol.

PLATE XIX.



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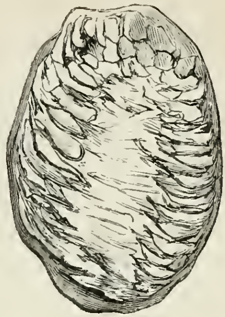

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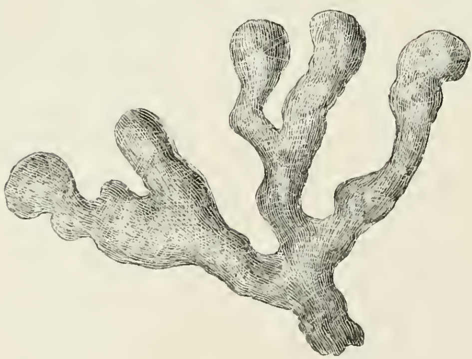


4

FOSSILS FROM THE KENTISH RAGSTONE, AT MAIDSTONE.

a portion of a small stem, eight inches long, which is converted into black flint, to the extent of six or seven inches, while the remainder is a friable carbonate of lime; the general aspect of this specimen, and the indications of eight irregular branches, prove at once its exogenous character. The cone found associated with this wood is in every respect such a fruit as a tree of the kind above described would produce. It bears a close resemblance to a fossil from the Greensand of Dorsetshire, discovered by Dr. Buckland, and figured in the 'Fossil Flora of Great Britain' under the name of *Abies oblongata*. In its general form, and in the shape of the scales and seeds, the Maidstone specimen is decidedly distinct. Unfortunately, the outer surface is so much worn that the external figure of the scales cannot be accurately defined, but the sections show their proportionate thickness; and as Abies is distinguished from Pinus by the thinness of the ends of the scales, the affinity of the fossil is clearly pointed out. There is an opening at the base of the cone occasioned by the removal of the stalk (Pl. xix. fig. 1), and an accidental oblique fracture exhibits the internal structure. In the longitudinal section thus exposed (fig. 2), the scales are seen to be rounded and broad at their base, and to rise gradually and become thin at their outer terminations (fig. 3). The seeds are oblong, and one seed is embedded within the base of each scale; in some instances there appears to be the remains of the embryo." There are about twenty-three seeds observable in the sections.

This limestone group is followed by a series of chert beds or siliceous hassock. The chert is nearly black, and in places very shattery; the more solid parts are very hard. An interesting occurrence took place a few years since, which elucidates in one way how flint veins in the chalk may be shattered *in situ*, as they are seen to be in some localities in the Isle of Wight. The stone is thrown down in my quarry in immense quantities, and in the fall of a large mass of some hundreds of tons the concussion so acted upon the brittle texture of the chert-seams as to shiver them into thin fragments, while the limestone with which they were intercalated in the block was scarcely at all affected.

The next group of strata, which, from the occurrence in it of the bones of that reptile, I have called the Iguanodon group, consists of two thin layers of very light-coloured limestone with intercalated seams of hassock, much of the loose and "shaky" portions of which consist of stems and nodules similar to the *Spongites Benstedii*.

Hitherto very few shells have been met with, but in this group we find the first distribution of a very characteristic one, *Trigonia alæformis*. A Trigonia, but of another species, *T. spinosa*, occurs in the upper bed of irregular ferruginous stone; the specimens of which are usually converted into chalcedony having the lines upon the shells clearly defined, but in these Iguanodon beds casts only are met with, a residue of white powder being all that remains of the shells; it is thus very rarely that the fossils can be extracted from the stone, little more than the impressions in most cases remaining.

The remains of Iguanodon were discovered in 1834, after the blasting of one of the layers. The bore being placed in the middle of a rise or mound in the stone, the separation of the mass was so complete, that some parts were thrown by the force of the powder to a considerable distance, and a month elapsed before I could fit the fragments together in their relative places. Fortunately there was no intervening piece lost; and the mass, as shown in the drawing, was completely put together. It is probable, however, that more of the skeleton had been embedded in the surrounding stone, and had been removed by the workmen previous to the blasting out of the portion preserved. This is the more likely, as I took every precaution to search what remained of the bed in every direction around the spot where it was found for some time afterwards, but without success.

I then constructed a shed to cover the specimen, and set to work to chisel away the stone covering over the bones. As the enormous proportions of the femur became developed, the interest of the work increased in a great degree; and not having any one near me sufficiently acquainted with comparative anatomy to help me to a knowledge of the structure of this novelty, and finding the characters of the bones to differ so widely from any drawings I could get access to, I acquainted Dr. Mantell with my discovery. From the plates in his excellent work, 'The Geology of the South-East of England,' I formed the opinion that my specimen was a large portion of the skeleton of the great herbivorous reptile, the Iguanodon—an opinion the Doctor concurred in when shortly afterwards he inspected the specimen.

The bones thus obtained consisted of two thigh-bones, each 33 inches long; a leg bone (tibia), 30 inches; a chevron-bone, or one of the inferior processes of the tail, 12 inches; the metatarsal and phalangeal bones of the hind feet; two claw-bones (unguical phalanges), which were covered by the nail and claw; two fingers or metacarpal bones of the fore-feet, 14 inches; a radius; several dorsal and caudal vertebræ; fragments of several ribs; the two clavicles; and two large flat bones, apparently parts of the pelvis.

The next bed below the Iguanodon strata is the "Molluskite Hassock,"—a layer of hassock containing an immense accumulation of dead shells, drifted wood, and a great quantity of round masses of a dark animal substance. The shells are chiefly those of *Trigonia alæformis*, but *Nautilus elegans* is of frequent occurrence; and by judicious cleavage of the layer, most interesting groups of fossils are obtained. The brown masses of animal matter or molluskite is chiefly contained within the cavities of the shells, with whose white shell-substance it strangely contrasts. A fine specimen of a sauroid tooth was found by me in this stratum, and presented by me to Professor Owen, who named it *Polyptychodon continuus*, and favoured me with the following observations upon it:—"The tooth belongs to one of the largest and one of the rarest of the extinct gigantic marine Saurians, characteristic of the chalk and greensand formations. Some enormous bones of the *Polyptychodon* were discovered in a greensand quarry at Hythe, and were presented by H. B. Mackeson, Esq., to the British

Museum. Your tooth belongs to the species *continuus*, so called on account of the enamel being continued from top to bottom; the dentine is compact, and has been resolved by decomposition into a series of superimposed hollow cones; the pulp-cavity is confined to the base of the crown, by which it differs from the teeth of the Hypsodon."

A paper was read before the Geological Society on the peculiarity observed in this layer, of the cavities of the shells being filled with molluskite. In the blocks of "firestone" or Upper Greensand, which are visible at low-water along the shore at Southbourne, Sussex, small concretions of phosphate of lime are thickly interspersed amongst the fossil shells. In my earliest geological researches along the Sussex coast, these fossil bodies particularly arrested my attention; but I failed to obtain any clue to their origin until the important memoir on coprolites, by Dr. Buckland, pointed out the right path of inquiry, and gave the clue to the formation of molluskite from the animal matter of the shell-fish.

That a large proportion of these phosphatic concretions and nodular masses are the mineralized egesta of fishes and other marine animals, there can be but little doubt, although it is rarely, if ever, possible to detect any traces of the convolutionary form of the intestines through which they have passed, and which are always more or less strongly impressed on the coprolites of the Chalk, Wealden and Lias. In the Southbourne rocks, however, instances are very common in which the phosphatic matter occurs as casts of shells, especially of the genera Venus and Trochus, which abound in the firestone beds; the substance of which casts appears, therefore, to have originated from the soft bodies of the mollusca that died within them. In Sussex, these phosphatic nodules are very abundant in the layers of the firestone which form the junction with the Gault. They are also frequent in the beds of Gault at Ringmer and Nortington, near Lewes, and in the Surrey strata. They also occur at Folkestone, in Kent. At page 296, I also mentioned the occurrence of similar nodules at New Hythe. The late Dr. Fitton, in his elaborate memoir 'On the Strata below the Chalk' (Trans. Geol. Soc. vol. iv. pl. 2, p. 111), has given a description and analysis of those coprolitic nodules and concretions which occur at Folkestone. He says, "They resemble coprolites in their chemical composition, though no traces of animal structure are apparent in them. They sometimes enclose portions of shells, but no fragments of bones or scales of fishes.* In some cases they are of very irregular figure, surrounding or incorporated with fossil remains, the interior of which is filled with matter of the same

* In some few cases I have found fish scales and small teeth of sharks in those at Folkestone. Shell-casts, especially of Dentalia, are very common; and one very important layer in the Gault at Folkestone is entirely formed of the more or less broken casts of ammonites. Portions of wood are extremely common in the nodules forming the junction bed of Gault and Lower Greensand there. Fossil oyster-shells and serpula are very commonly attached to their exterior surfaces, showing they were consolidated whilst lying at the bottom of the Gault and Greensand seas, and before they were embedded.—Ed. Geol.

kind." The remark last quoted bears directly on the point noticed in the ragstone hassock in my quarry.

In the grey Shanklin sand these nodules abound in some localities. I have observed them in Sussex, in Surrey, in the Isle of Wight, near Ventnor, and in many parts of Kent. In vol. iv. (p. 35) of the Geological Society's Proceedings, Dr. Mantell writes, "Mr. Bensted having long paid attention to this subject, submitted to my inspection several specimens of *Rostellaria*, *Trigonia*, and other shells, the cavities of which were filled with a dark-brown substance, in many respects identical with the nodular and irregular concretions of coprolitic matter which abound in the surrounding sandstone. At the same time, Mr. Bensted expressed his conviction that the carbonaceous substance was derived from the soft bodies of the mollusca, and that the concretionary and amorphous portions of the same matter dispersed throughout the sandstone of the bed were fossilized masses of the soft bodies of the animals disengaged from their shells, and which had floated in the sea until enveloped in the sand and mud which is now converted into the sandstone called the Kentish Rag. The evidence collected by Mr. Bensted appears to me so conclusive and so confirmatory of the opinions previously stated, that I beg to place before the Society the following abstract of his correspondence with me upon the subject:—'The bed of Kentish Rag in my quarry, which lies immediately beneath the stratum that contained the remains of the Iguanodon, abounds in the usual shells of the Lower Greensand, but more particularly in Trigoniæ (generally *T. alæformis*), and there is an abundance of a dark-brown coprolitic-looking substance, of which I send specimens.

"'In some instances this material actually forms the entire casts of the univalves and bivalves, and I think there can be no doubt that it is derived from the soft bodies of the animals which inhabited the shells found in connection with it fossilized in this peculiar manner. There are many examples which look more like true coprolites of fishes, and some of them contain shells partly crushed, as if they had been the undigested contents of the intestinal canal. I am therefore inclined to think that the dark material which now occupies the shells was the soft body of the mollusk; that those masses of a concretionary form which are embedded in the stone are coprolites; and that the shapeless portions of this substance distributed in the rock have originated from floating masses of the bodies of the dead shell-fish. In illustration of the manner in which such an accumulation of materials as I find in my quarry may have been formed, I beg to call your attention to the following extract from the American Journal of Science:—"One of the most curious phenomena of the year 1836 has been the fatal effect of an epidemic disease among the molluscous animals or shell-fish of the Muskingum River, Ohio. It commenced in April and continued until June, destroying millions of that quiet retiring race which peoples the bed of streams. As the animal died the valves of the shell opened, and decomposition commencing, the muscular adhesions gave way, and the fleshy portion rose to the surface of the water, leaving the shell on the bed of the stream. As the dead bodies floated down the current the heads of islands, masses of fixed drifted wood, and the shores in many places were covered with them, tainting the air with putrid effluvia.'"

Now, nearly the whole of the shells which occur in this bed of ragstone appear to have been dead shells. I mean, that from the open state of the valves it is probable that the animals were for the most part dead before they were enveloped in the sand and mud; and from the large quantity of waterworn (coniferous) wood perforated by lithodomi, that is imbedded with them, it would appear that this stratum had constituted a bank of drifted wood and shells, presenting a very analogous condition to the phenomena above described. The molluscous bodies of the trigonias, gervillias, rostellarias, and oysters, etc., detached from their shells, would have been intermingled with drift-wood on such a sandbank; while, in other cases, the animal-matter would remain in the shells. These masses becoming fossilized would present when loose the patches of molluskite, and when retained in the shells the phosphatic casts observed.

The Rev. J. B. Reade submitted some of the molluskite to an analysis by Mr. Rigg, who confirmed Dr. Mantell's suspicion of the presence of animal-carbon in it, and states that the darker portion of the substance contains about 35 per cent. of its weight. Dr. Mantell adds that a microscopical examination of some specimens with a low power detects innumerable portions of the nacreous laminæ of shells of extreme thinness, intermingled with carbonaceous matter, together with many siliceous spiculæ of sponges, very minute spines of Echinodermata and Polypifera. Of these extraneous bodies he remarks, that probably they became intermingled in the soft animal-mass before the latter had undergone complete decomposition. He proposed the term Molluskite for this fossil substance, and considers the substance of the dark spots and markings in the Purbeck marble to be identical. Since this paper was read, I have closely examined many of these bodies, and from the presence of minute bones of fishes, I am convinced that a very large proportion are the egesta of fishes.

(*To be continued.*)

CORRESPONDENCE.

The Muskham Skull.

Sir,—Have the following facts, stated by an anatomist of European reputation for the last thirty years, any bearing on the question of the obliquity of the *foramen magnum* in the Muskham skull, as described by Prof. Huxley and Mr. C. Carter Blake, in the 'Geologist' for June last?

Speaking of the Kaffirs, Dr. Knox states ('Races of Men,' p. 226), that "the form of the skull differs from ours, and it is placed differently on the neck; the texture of the brain is, I think, generally darker, and the white part more strongly fibrous; but I speak from extremely limited experience." Speaking of the Hindús, he states ('Races of Men,' p. 246), that two young Brahmins which he saw had "heads peculiarly formed—hammer-shaped, in fact—set on the neck differently from the European."

It is to be hoped that the forthcoming detailed examination, by Dr. Knox and Mr. Carter Blake, of a large series of recent skulls in the Ethnological Society's collection, may lead to some satisfactory result on this interesting question.—I am, etc.,

POLYGENIST.

Flint Implements.

SIR,—One or two statements made in an article which appeared in the 'Geologist' of last month, on M. Gras' attack on the evidence of the Flint Implements in respect to the antiquity of man, seem to me to require correction.

In touching upon one of the points of M. Gras' attack, viz. "the astonishing multitude of these axes," the following interrogative is put and answered:—"But, in reality, *how* common are the true worked flints? We have seen *one* only from all the great gravel-beds round and under London; and miles of them have lately been cut through for the sewer-works. We have seen, may be, half-a-dozen from Suffolk, a like number from Bedford, two or three from Kent, and less than a dozen from all parts of England. As to the Yorkshire specimens, we must know more about them, and *where* they come from, before we can say much about them. I suppose, however, whether *ancient* or *modern*, not more than a hundred exist from that, the largest county in England, and numbering as many acres as there are words in the Bible."

From the above extract it appears that considerable doubt exists as to the genuineness of the numerous collections of flint-implements made by various individuals in the last-named county. About twenty years ago, I casually saw at Boynton Hall, which is situate a few miles from Bridlington, and which belongs to Sir George Strickland, a small but interesting collection of flint arrowheads, axes, etc., made previous to the year 1800. It was after my inspection of this collection that I was induced to search in the same localities; and during the period above-mentioned, I have accumulated several thousands; nine-tenths I have picked up myself, and the rest have been brought to me by men and children who have found them while working in the fields. I beg to refer your readers to a lecture delivered by the Rev. T. Wiltshire to the Geologists' Association at the beginning of the year, on the "Ancient Flint Implements of Yorkshire, and the Modern Fabrication of similar Specimens." On this occasion the reverend gentleman exhibited two hundred and sixty-eight specimens. To show, however, with what facility spurious flint weapons could be manufactured, a person was in attendance who, with only a small piece of iron rod, bent at the end, produced by a little dexterous manipulation almost any shape required. The forged implements, however, may be detected by the practised eye, as there are certain peculiarities about them which make them differ from the authentic ones. Those interested in such matters I would refer to a report of my collection, which appeared in the third volume of the Proceedings of the Leeds and West Riding of Yorkshire Philosophical Society; and also to 'The Celt, the Roman, and the Saxon,' by T. Wright, Esq.

At the conclusion of the article alluded to, the following question is asked: "Will M. Gras assert he has ever seen a pointed weapon either ground or polished?" As this question is put to M. Gras under the impression that there are no such pointed tools or weapons, I may state there are such in my collection, though I confess they are by no means common, for, during the whole period that I have devoted to collecting these things, I have found but three.

The majority of my rudest weapons and tools were found at greater depths, generally speaking, than those which are more elaborately worked, and the transition in Yorkshire from the rude to the more highly finished implements may be said to have been gradual and apparently uninterrupted; for we find on the same land at various depths, first the most artistic, then a little lower others ruder in shape, and a few inches above the Chalk they are found amongst gravel through which water highly charged with oxide of iron has percolated, thereby changing the colour of the flints there embedded, which are generally very rude in their make. Many of the arrowheads and spear-points exhibit quite a porcellaneous appearance, which betokens their great antiquity. Those discovered in sandy places are of the natural colour, but are very bright on the surface.

There can be little doubt that flint-implements were used up to a comparatively late date.* If in Yorkshire-weapons and tools to be coated with *carbonate of lime* and *stained with oxide of iron*, and also ground at the point, be an indication of their antiquity, then the Yorkshire flints are as old as any hitherto found. And why should it not be so? "seeing that we find ordinary *gravel*-flints in myriads on the surface of the soil. Can you go through any field, over any downs, across any chalk country, and not pick up, if you please, tons upon tons or cartload upon cartload? If one sort, why not then another? Is the proportion of flint-implements to unworked stones likely to be less in the disintegrated gravel-bed strewn over the soil than in the solid untouched stratum lying intact in the earth? And if not, are we less likely to find flint-implements on the surface of the soil than in the gravel-beds beneath it? We are sure we need not reply to these questions: our readers will have answered for themselves."

Yours, etc.,

Bridlington, Yorkshire. EDW. TINDALL.

[The article on M. Gras was written by me, and why my name did not appear was quite a matter of accident. All the world knows that I never hesitate to speak out; but all the world knows that if I do say a thing not exactly kind I have good grounds—or at least sincerely believe I have—before I say it. I have said I am satisfied some of the so-termed "haches reputed to be from St. Acheul" *may* be "haches" from St. Acheul, but are not fossil "haches" at all. They are rank forgeries. With respect

* It was the constant policy of the Romans to draught off the rising population of the conquered provinces, and send them to occupy stations, and, in fact, to form colonies in other countries. We find mentioned in old writers and in inscriptions numerous *alæ* and cohorts of Britons in various parts of the Roman empire. According to the 'Notitia,' the fourth *ala* of Britons was stationed in Egypt. The twenty-sixth cohort of Britons occurs in Armenia. A body of the "Invincible Younger Britons" were stationed in Spain; and one of the "Elder Britons" in Illyricum. The "Younger British Slingers" (*funditores*) are found among Palatine auxiliaries. See Wright's 'Celt, Roman, and Saxon,' foot-note, p. 104. See the above-mentioned 'Notitia,' book iv. chap. x. pp. 199, 200, etc.

to the Yorkshire so-termed fossil specimens, I do admit that I am not a believer in them. I have seen so many deliberate forgeries from thence that I did not require the practical performance before my eyes of a Yorkshire flint-chipper to satisfy me how able some of the natives of that county were to "come Yorkshire over" us natives here. Our readers are referred to Mr. Wiltshire's paper, which we have read long ago,—but what is there in it that has anything to with the question of the *fossil* flint-implements of Yorkshire? Mr. Wiltshire takes up an historical topic, and deals with flint-implements from *graves* and *entrenchments* at Fimber,—entrenchments, the origin of which he attributes to the Brigantes. These Fimber weapons are flint flakes, arrow-heads, and sling-stones: none of the first more than two inches long, and none of the latter more than about an inch. All this is very far away from the subject of gravel-drift implements.

Reference is made in our correspondent's letter to the exhibition of 268 specimens of, I presume the writer means our readers to infer *real fossil implements*, by Mr. Wiltshire, on the reading of his paper before the Geologists' Association. Now does Mr. Tindall really mean to say that 268 genuine large *pointed implements*, from gravel or any other geological deposit of Drift age, were then shown or even have been found in Yorkshire? I mean such old implements as we talk about when we speak of the Abbeville, St. Acheul, and Hoxne implements. I was not present at that meeting, and therefore did not see the collection referred to, but I do not believe it contained ten—if, indeed, *any* such at all. And did not that number include arrowheads, flakes, and all sorts of things?*

Large pointed implement ($\frac{1}{4}$ nat. size).

That there may be no mistake about the sort of flint implements we mean, we annex a woodcut ($\frac{1}{4}$ nat. size) of the pointed kind, to which our remarks are restricted.

Mr. Tindall tells us he has three pointed tools with ground points: will he kindly transmit them to us for inspection, and will he tell us were not these found on the surface or in graves? If Mr. Tindall has three real fossil pointed implements, *ground*, he may pride himself on their uniqueness, and geologists on having got another evidence of the progress of the primitive men in their flint-chipping art, and a consequently additional proof of the primitiveness and antiquity of the unground implements; but they will be of no value to anybody unless the exact locality or conditions of the discovery is accurately narrated.

Mr. Tindall further states, that the deeper down in the Yorkshire beds the more primitive the weapons; and that there is a regular stratigraphical order of the advance of the workmanship. Will he tell us any one such section that will bear the inspection of ourselves, or Mr. Prestwich, Mr. Evans, or any other competent geologist. Will he furnish us with a list of the weapons found in Yorkshire by himself and others, and give the locality and stratigraphical and archæological conditions of each find? In this way, if right, he will do science the greatest service; if wrong, then the world will justify our scruples respecting the Yorkshire implements.

* In Mr. Wiltshire's paper it is stated that he exhibited 268 flint implements found by Mr. Mortimer and his children at Fimber. These were therefore historic and not fossil implements at all.—S. J. M.

In these remarks we mean nothing whatever of personal reflection on Mr. Tindall, from whom, on all occasions when we have required it, we have received the greatest courtesy; but we think he is mistaken in respect to the nature both of the implements he has in his own large collection, as well as those he has seen in other collections.

Our opinion is that the mass of any real (*i.e.* not forged) flint-implements or weapons found in Yorkshire belong to a later or more immediately prehistoric period than that of the Drift gravels, and may come from graves or the débris of graves or be strewed on the soil. So far as I have seen, the Yorkshire large-pointed specimens are far smaller than even the smallest of the Abbeville and other true Drift examples, and it is highly desirable that the most reliable evidence be given to the world of their actual stratigraphical position. Mr. Tindall and other collectors and writers on this topic should remember, that where the practised eye has to judge of mere manipulatory results, the finest and most delicate differences may be of the greatest value. Let Mr. Tindall supply these facts. Let him give us the list of the Yorkshire implements and their localities, and give with each its position in the earth's strata, or state what other relics were found with it in the same grave, and then we shall have something tangible to work upon, and shall not spoil good paper in vague surmises and vain assertions. I have no preconceived views to advocate, I only want to get at the truth; and I do not mind what side I take, provided only that it really be the *right* side; but I do think the questions involved in these considerations so important that the evidence should be most searchingly investigated in every case before it be accepted; and it would be worse than culpable for the editor of the 'Geologist' knowingly to allow such a jumble of historic with fossil relics to pass unravelled. Science wants no man's assertion: she requires all the evidence on this topic to be well substantiated, and to be supported by abundant testimony.—S. J. Mackie.]

GEOLOGICAL NOTES IN THE GREAT EXHIBITION.

South Australia.—The main feature in this colony is the Mount Lofty Range, or Adelaide Hills, as they are indifferently called, which, about 30 miles in length from north to south, rise to an elevation of 2400 feet, and wooded to their summit. Between these hills and the sea are the great Adelaide Plains, so notable for their great crops of wheat and other corn. The chief topics, however, for our notice, are the mineral products. The chief source of mineral wealth in South Australia is copper. The Burra-Burra mine has long been famous, while the astonishing yield of some of the mines on Yorke's Peninsula brings them into perfect rivalry with it. Again, to the north of Spencer's Gulf mineral discoveries of the highest value have been made, and only the requisite facilities for transport—labour and capital—are required to develop them. It is in that district that the works of the Great Northern Mining Company are in operation.

The Burra-Burra mines—the vast productiveness of which is of worldwide celebrity—are about 90 miles N.E. from Adelaide, and the works were commenced, in 1845, in the copper rock which projected from the surface, with ten miners, a smith, and a captain. They now yield employment directly to upwards of 1100 persons. Although the works were at first carried on in a very rude manner, the produce of the first six years was 80,000 tons of ore; and although the bulk of that ore had to be carted over a hundred miles of road and then shipped to a market 16,000 miles distant, the profit obtained was no less than £438,500; the company's capital, in 1845, being the modest sum of £1500. This prosperous career, however, received a check in 1851, when the discoveries of gold attracted all classes from their usual occupations to New South Wales and Victoria. In 1852 the number of hands was then reduced to 366, and subsequently to 100; the pumping-engines were stopped, and the operations limited to the dry levels. This continued until 1854, when the Governor of the Colony, Sir H. E. F. Young, introduced a number of Cornish miners; and in January, 1855, the pumpings and lower workings were resumed. Subsequent results have not been so brilliant as the first essays, as the increasing depth of the mine leaves less profit on the quantity extracted; but there is not, however, any falling off in the supply. The annual yield of ore for many years past has been from 10,000 to 13,000 tons, yielding from 22 to 23 per cent. of copper; in round numbers about 2500 tons of the value of £225,000 per annum.

The Kapunda mines are about 50 miles N.E. of Adelaide. The ore was first discovered jutting out of the soil, in 1843, during a search for some stray sheep, and the first loads were extracted in 1844. Three or four years later, a 30-inch cylinder pumping engine and crushing machinery were erected. A larger engine was erected in 1851, and both were employed, the workings having attained a depth of 60 fathoms. In 1849 smelting works were built; but in 1850 the gold attractions in Victoria caused most of the men to leave; and the smelting works were not resumed until 1855. The ores comprise almost every variety, as yellow ore, or pyrites, blue and green carbonates, muriates, grey and black sulphurets, oxides, bell-metal and peacock ores, and native or malleable copper. The percentage varies from 66 per cent. downwards. The entire quantity of ore raised from the commencement of the mines to 1861 inclusive was 35,280 tons of the average yield of 20 per cent. The quantity raised during the past year was 3306 tons of 18 per cent. average. All the ores raised are now reduced to fine copper before shipment. In 1861, 595 tons were shipped, and £8713 were paid for fuel for the smelting works—timber alone being used.

Whether the mineral wealth of Yorke's Peninsula will prove equally considerable, time only can show; but mines there have the immense advantage of ready access to the seaboard. The most prolific mines opened are those at Wallaroo Bay. The Wallaroo mine was discovered in 1859, and in the following year four Cornish miners were employed. There are two principal workings; in one the sinkings are to 20 fathoms, and a drive of 40 fathoms has been made into the lode, which, like the generality of the lodes in the district, runs from east to west. At the east end the lode is 4 feet wide; at the west end 15 or 16. At the 10-fathom level drives have been made of more than a hundred fathoms. In the other workings the sinkings are to 25 fathoms, at the 20-fathom level drives of 115 fathoms, and at the 10-fathom level drives of 155 fathoms, the lode varying from 4 to 20 feet in width. The total quantity of ore raised up to January, 1861, was 11,370 tons, of which 5370 have been shipped to Melbourne and Sydney, and about 6000 tons have been reduced in the smelting furnaces on the mine. The ores average 15 to 25 per cent. in richness. The Moonta mines are situated about 10 miles distant, south by west, and close to the coast. They have been only recently opened, but are of immense promise. The quantity of ore now being raised is upwards of 100 tons per week, and the ore raised yields a higher percentage even than Wallaroo, but little by below 20 per cent., and a great deal yields 30 per cent. Near the surface the ore is chiefly green carbonate mixed with clay; but at 7 or 8 fathoms down it has changed to black and yellow ore, interspersed with large lumps of metallic copper, some of several pounds weight. The first discovery of these rich deposits was in May, 1861. Next to the Wallaroo and Moonta mines, the most successful operations have been those of the "New Cornwall Mining Association." Their workings are 3 or 4 miles inland from the Wallaroo mines, and about 45 men are now employed. From the lodes intended to be worked by the engine 800 tons have been raised, some giving the high yield of 40 per cent. At these works the ore will be reduced by a process recently patented by Mr. R. V. Rodda. The workings of the Duryea Mining Company are about 3 miles from Kadina. At 18 feet below the surface green carbonate of copper was met with. At 20 feet below the surface drives were made in various directions, and in each copper was cut, in all cases dipping down; at 25 feet water was met with, another shaft was then commenced; and at 10 feet a fine course of mundic, with black quartz, was met, beneath which was a fine lode of black ore, 7 feet to 8½ feet thick, dipping to the south. Specimens were assayed, and gave 64 per cent. of copper. At 12 fathoms a drive was made from one shaft to the other in which 2 wingers were sunk, one 9 fathoms and the other 4 fathoms. From these cut black ore has been raised, yielding from 52 to 57½ per cent. of copper. Several mines, besides the Great Northern Company, have been opened in the tract of country north of Port Augusta; but though several of them are of high promise, want of capital and the difficulty of getting the ore to a shipping place have prevented the development of active operations. The Great Northern mines are about 290 miles north of Port Augusta, and working operations commenced in June, 1860, and have been prosecuted with considerable vigour and success. Some 600 or 700 tons of ore, extracted without machinery, have been shipped to this country. These have been the usual carbonates and grey ores giving a high produce—27 to 30—and some as high as 40 per cent.; but the present deep levels are turning out sulphurets.

Near Strathalbyn several mines producing copper and lead were opened many years prior to the discovery of gold in Victoria, and considerable returns made from them. More recently, the Wheal Ellen mine in the same locality, producing lead, silver, and copper, with gold in the gossans, has been discovered. In the Bremer country a number of mines were opened also before the discovery of gold in Victoria, many which gave great promise of large results. Working has been renewed in one of them—the Bremer mine. The Kanmatoo mines on the estate of the South Australian Company have been worked for many years past, and large quantities of ore raised. Smelting furnaces for the ore have been raised in Scott's Creek, some four miles distant, and have tended largely to increase the profits of the undertaking. The whole of this district is highly mineralized.

Geological Institute of Austria.—This institution was founded by the present Emperor, Francis Joseph I., in 1859, under the directorship of Dr. Haidinger. The local directors are MM. Hauer, Lipold, and Foetterle. The staff of assistant-geologists consists of M. D. Stur, Dr. Stache, M. Henry Wolf, Baron Andrian-Werberg, Dr. Stoliezka, and M. Chas. Paul. The archivist is Count Marschall von Burgholzhausen; the director of the chemical laboratory, M. Hauer; the librarian, M. Adolphe Senoner; and Dr. Hörnes, the director of the Imperial Mineralogical Museum of Vienna, is an associate member of the staff.

The province of the Institute is to collect materials for elucidating the geology of the Austrian Empire, the order of its labours being:—1. The geological exploration of the whole Austrian Empire. 2. The collecting of specimens and arranging them in a Central Museum. 3. Chemical analyses to be carried on with the minerals collected. 4. Chemical analyses to be extended also to the interest of mining and smelting ores. 5. Geological maps to be constructed and published. 6. Publications to be carried on, giving the results of the work of exploration. 7. A library and archives to be opened to assist the studies and labours of the persons employed.

A yearly grant of 36,000 florins (about £2760) is appropriated for these purposes. At first the Museum was placed in the palace of the Imperial Mint; but the collections soon increasing, it was necessary to remove it to another more convenient place, and one of the palaces of Prince Liechtenstein was rented for the purpose. An extraordinary grant of 10,000 fl. was devoted in 1849 to the first arrangements, and two other special grants, the latter of them to the same amount, have been since passed for the expense of publication of Dr. Hörnes' 'Fossile Mollusken.'

The articles sent to the Exhibition are:—

I. *Geological Maps.*—There are three different sets of Geological Maps. They are all grounded on the publications of the Military Geographical Institute and the field-work of the General Quartermaster Staff. The following are finished in the greatest detail the published maps will allow, on the scale of one inch to $2\frac{1}{4}$ English miles (2·25225):—1. Upper and Lower Austria. 2. Salzburg. 3. Styria and Illyria. 4. Bohemia.

The following are general maps, executed on the scale of one inch to $4\frac{1}{2}$ miles:—5. Tyrol and Vorarlberg. 6. Lombardy and Venetia. 7. Hungary and Croatia. 8. The Banat of Temesvar.

The following, also general maps, but executed on the still smaller scale of one inch to $6\frac{3}{4}$ English miles (*cartes routières*):—9. Transylvania. 10. Galicia.

The lists of the colours and signs employed in geological maps necessarily gives the order and succession of the recognized divisions of the earth's strata; and thus, although designed for one purpose, they manifestly effect another. The following general view of names of deposits and rocks refers to the ten excellent maps exhibited by the Austrian Geological Institute, explanatory of the colours and signs employed in these maps, thus gives a valuable list of the divisions and subdivisions of the Austrian beds, which we think it well worth while to find a place for in this journal.

By comparing such lists with others, such as that of our own Geological Survey, students will get a fair idea of the comparative synchronisms of the various periods indicated in these classifications. The Austrian list shows no less than 174 different shades of colours, partly pure, partly combined with signs, particularly of differently coloured lines in various directions. The same tint gives the general idea of sameness of rock or deposit; the numbers express more detailed references. It may here be observed that in the Austrian list, beginning with Alluvium, the order of names denotes the strata following each other in a descending order, down to 96 and 97 (the sandstones, slates, and limestones of the Carboniferous series). But M. Barrande's Silurian rocks of Bohemia, from B to H, or from No. 98 (the Pribram slates) to No. 112 (the Hlubocep strata), follow an ascending order in the Austrian list, but have been transposed into descending order in that we have printed at page 350; the rest, from No. 113 to No. 127, is again descending; and then the massive and mostly crystalline and eruptive rocks from granite, No. 128 to No. 160 (extinct volcanos), are again arranged in ascending order; while numbers 160 to 174 are devoted to various references. It should be observed, also, that the arrangement of the consecutive numbers is not of a kind to imply, even for the first 97 numbers, the necessity that every subsequent stratum really should be inferior in position to every preceding one. On the contrary, several of them in one map may be employed only for a system of deposits, while, in another, geologists have succeeded in ascertaining a number of consecutive members perfectly distinguishable from one another. In some maps of distant regions the same sign has been casually employed for quite different rocks or strata; and from these observations it will be seen that the Austrian geologists do not pretend to give a geological system, consistent throughout within itself, as might be done in a treatise on geology, but merely the result of their studies in their present state, as they are drawn up and brought to a general survey for the present International Exhibition.

1	Alluvium	Alluvium.	
2		Peat.	
3		Calcareous tufa.	
4		Calcareous tufa.	Hungary.
5	Diluvium	Erratic deposits.	Ga lici
6		Erratic blocks.	Austria.
7		Moraines.	Styria, Carinthia.
8		Loam.	
9		Gravel and conglomerate.	
10		Gravel and conglom.	Bohemia.
11	Tertiary Neogene	Freshwater limestone.	Hun. Gal.
12		Freshwater quartz.	Hungary.
13		Freshwater limestone.	Bohemia.
14		Gravel.	
15		Congeria sand.	Hungary.
16		Congeria clay.	
17		Cerithium beds.	
18		Cerithium limestone.	
19		Sand and sandstone.	
20		Leitha limestone.	Austria and Hungary.
21		Leitha conglomerate.	
22		Baden clay.	
23		Lignite measures.	Styria.
24	Upper Eocene	Menilite slate.	Austria.
25		Menilite slate.	Galicia.
26		Freshwater formation.	Hungary.
27		Younger Carpathian sandstone.	Galicia.
28		Sandstone.	Tyrol.
29		Gravel and clay.	Hungary.
30	Middle Eocene	Nummulitic sandstone.	Austria.
31		Conglomerate.	Istria.
32		Nummulitic limestone.	
33		Main nummulitic series.	Transylv.
34	Lower Eocene	Freshwater deposits.	
35		Cosina series.	Istria.
36		Conglomerate.	Transylvania.
37	Cretaceous.	Marly sandstone.	Gosaubeds, Austria.
38		Limestone.	
39		Conglomerate.	
40		Scaglia.	Lomb. Venetia.
41		Senonian sandstone.	Istria.
42		Senonian limestone.	

43	Cretaceous.	Hippurite limestone.	Lomb. Ven. Hung.
44		Rudistes limestone.	Istria.
45		Radiolite limestone.	
46		Comen slate.	
47		Radiolite dolomite.	
48		Caprotina limestone.	Istria. Hungary.
49		Baculite beds.	Bohemia.
50		Pläner.	
51		Upper Quader.	
52		Quader marl.	
53		Quader sandstone.	
54		Gault and Seewer.	Tyrol.
55		Spatangus limestone.	
56		Neocomian dolomite.	Hung.
57		Marl.	
58		Teschen slate.	Galicia.
59		Vienna sandstone.	
60		Rossfeld series.	Salzb. Tyr.
61		Aptychus slates.	
62		Biancone, Majolica.	Lomb. Ven.
63		Wealden.	Austria.
64	Oolite	White limestone.	Austria.
65		Plassen limestone. (Stramberg series).	Aust. Istr. Banat.
66		Vils series.	Hungary.
67		Klaus series.	Austria.
68		Klaus series with hornstone.	Hungary.
69		Woltschach limestone.	Istria.
70		Crinoid limestone.	Austria.
71		Oolitic limestone.	Istria. Lomb. Ven.
72	Lias	Hierlatz and Adneth series.	
73		Variegated marl.	
74		Kössen series.	
75		Dachstein limestone.	
76		Dachstein dolomite.	
77		Gresten limestone.	Austria. Lomb. Ven.
78		Gresten dolomite.	
79		Gresten Rauchwacke.	
80		Gresten sandstone.	

No.	Group	Rock / Series	Etages of M. J. Barrande	Locality
81	Trias	Raibl and St. Cassian series.		Carinthia. Carniola.
82	Trias	St. Cassian series.		Tyr. Ven.
83	Trias	Grossdorn series.		Carniola.
84	Trias	Hallstatt limestone.		
85	Trias	Hallstatt dolomite.		
86	Trias	Esino and Hallstatt series.		Tyrol.
87	Trias	Triassic dolomite.		Hungary.
88	Trias	Guttenstein limestone.		
89	Trias	Guttenstein dolomite.		
90	Trias	Guttenstein Rauchwacke.		
91	Trias	Radstatt limestone.		Salzburg.
92	Trias	Radstatt slate.		Salzburg.
93	Trias	Werfen slate.		
94		Old red sandstone.		Bohemia.
95		Old red sandstone.		Galicia.
96	Carboniferous	Sandstone and slate.		
97	Carboniferous	Limestone.		
98	Silurian System in Bohemia	Hlubocep. (strata)	H	
99	Silurian System in Bohemia	Branik. (strata)	G	
100	Silurian System in Bohemia	Koneprus. (strata)	F	
101	Silurian System in Bohemia	Kuhelbad. (strata)	E	
102	Silurian System in Bohemia	Litten. (strata)	E	
103	Silurian System in Bohemia	Kossow. (strata)	d^5	
104	Silurian System in Bohemia	Greenstone.	d^5	
105	Silurian System in Bohemia	Vinica (Hostomnitz, Zahoran)	d^3 d^4	
106	Silurian System in Bohemia	Brda. (strata)	D d^2	
107	Silurian System in Bohemia	Rokycan. (strata)	d'	
108	Silurian System in Bohemia	Komorau. (strata)	d'	
109	Silurian System in Bohemia	Krusnahora. (strata)	d'	
110	Silurian System in Bohemia	Ginec. (strata)	C	
111	Silurian System in Bohemia	Pribram greywacke.	C	
112	Silurian System in Bohemia	Pribram slate.	B	
113	Silurian	Siliceous slate.		Bohemia.
114	Silurian	Alum slate.		Bohemia.
115	Silurian	Sandstone, slate.		Aust. Styr. Hungary.
116	Silurian	Limestone.		Aust. Styr. Hungary.
117	Stratified and crystalline rocks	Clay-slate.		
118	Stratified and crystalline rocks	Chloritic slate.		
119	Stratified and crystalline rocks	Talcose slate.		
120	Stratified and crystalline rocks	Amphibolic slate.		
121	Stratified and crystalline rocks	Calcareous mica-slate.		Salzburg. Carinth. Hung.
122	Stratified and crystalline rocks	Granular limestone.		
123	Stratified and crystalline rocks	Mica-slate.		
124	Stratified and crystalline rocks	Gneiss.		
125	Stratified and crystalline rocks	Granulite.		Austr. Boh.
126	Stratified and crystalline rocks	Greisen.		Bohemia.
127	Stratified and crystalline rocks	Quartzite.		Bohemia.

No.	Group	Rock / Subject	Locality
128	Rocks in masses, mostly crystalline and eruptive	Extinct volcanos.	Bohemia
129	Rocks in masses, mostly crystalline and eruptive	Basaltic tufa.	
130	Rocks in masses, mostly crystalline and eruptive	Basalt.	Hungary.
131	Rocks in masses, mostly crystalline and eruptive	Basalt.	
132	Rocks in masses, mostly crystalline and eruptive	Trachytic tufa and conglomerate.	Banat. Transylv.
133	Rocks in masses, mostly crystalline and eruptive		Banat. Transylv.
134	Rocks in masses, mostly crystalline and eruptive	Rhyolite	Banat. Transylv.
135	Rocks in masses, mostly crystalline and eruptive	Grey trachyte.	Hungary.
136	Rocks in masses, mostly crystalline and eruptive	Phonolite.	Bohemia.
137	Rocks in masses, mostly crystalline and eruptive	Greenstone trachyte.	Hun. Tran.
138	Rocks in masses, mostly crystalline and eruptive	Porphyritic tufa.	Styria.
139	Rocks in masses, mostly crystalline and eruptive	Dioritic tufa.	Styria.
140	Rocks in masses, mostly crystalline and eruptive	Augite porphyry tufa.	Tyrol.
141	Rocks in masses, mostly crystalline and eruptive	Augite porphyry.	Hungary.
142	Rocks in masses, mostly crystalline and eruptive	Augite porphyry.	Tyrol.
143	Rocks in masses, mostly crystalline and eruptive	Melaphyre tufa.	Lomb. Ven.
144	Rocks in masses, mostly crystalline and eruptive	Melaphyre.	Tyrol.
145	Rocks in masses, mostly crystalline and eruptive	Melaphyre.	Hungary.
146	Rocks in masses, mostly crystalline and eruptive	Porphyry.	Tyrol.
147	Rocks in masses, mostly crystalline and eruptive	Green porphyry.	Bohemia.
148	Rocks in masses, mostly crystalline and eruptive	Porphyry.	Bohemia, Carinthia.
149	Rocks in masses, mostly crystalline and eruptive	Gabbro.	Hungary.
150	Rocks in masses, mostly crystalline and eruptive	Serpentine.	
151	Rocks in masses, mostly crystalline and eruptive	Greenstone.	Bohemia.
152	Rocks in masses, mostly crystalline and eruptive	Aphanite.	Bohemia.
153	Rocks in masses, mostly crystalline and eruptive	Diorite.	Bohemia.
154	Rocks in masses, mostly crystalline and eruptive	Diorite.	Tyrol.
155	Rocks in masses, mostly crystalline and eruptive	Diorite.	Austria, Banat.
156	Rocks in masses, mostly crystalline and eruptive	Eclogite.	Styria.
	Rocks in masses, mostly crystalline and eruptive	Amphibolite.	Carinth. Bohemia.
157	Rocks in masses, mostly crystalline and eruptive	Syenitic porphyry.	Boh. Ban.
158	Rocks in masses, mostly crystalline and eruptive	Syenite.	
159	Rocks in masses, mostly crystalline and eruptive	Granitite.	Bohemia.
160	Rocks in masses, mostly crystalline and eruptive	Granite.	
161	Various references	Coal or lignite.	
162	Various references	Pseudovolcanic localities.	Boh.
163	Various references	Salt.	Austr. Transylv.
164	Various references	Salt Formation.	Galicia.
165	Various references	Plastic clay.	Bohemia.
166	Various references	Slate-clay.	Bohemia.
167	Various references	Polishing slate.	Bohemia.
168	Various references	Gypsum.	Hungary.
169	Various references	Gypsum.	
170	Various references	Graphite.	Austr. Boh.
171	Various references	Iron-ore.	
172	Various references	Magnetic iron-ore.	Bohemia.
173	Various references	Porcelain earth.	Austria.
174	Various references	Veins and masses.	Austr. Boh.

II. *The Publications of the I. R. Geological Institute.*—These are the—

1. 'Abhandlungen der k. k. geologischen Reichsanstalt,' of which three volumes are published, in which are contributions by Prof. A. E. Reuss, Prof. Ch. F. Peters, John Kudernatsch, Prof. F. L. Zekeli, Prof. C. Ritter von Ettingshausen, and Dr. Ch. J. Andrae, in vols. i. and ii.; vol. iii. forming part of Dr. M. Hörnes' 'Fossil Mollusca of the Tertiary Vienna

Basin.' It is distributed as a free gift or on terms of exchange to 130 Austrian and 170 foreign institutes or persons.

2. 'Jahrbuch der k. k. geologischen Reichsanstalt,' of which nine volumes have been issued, containing contributions by members of the Institute and others, on the Geology of Austria, and kindred subjects, and comprising also the Proceedings of the Institute at its meetings, and reports of the exploratory excursions. The 'Jahrbuch' is distributed like the 'Abhandlungen,' but on a somewhat more extended scale, to 473 Austrian and 292 foreign institutes or individual persons.

III. *A Collection of Crystals of Salts* (M. Hauer), obtained in the chemical laboratory of the Institute.

IV. *A Collection of Specimens of Fossil Fuel* (M. Foetterle), consisting of peat, lignite, brown coal, black coal, and anthracite, of different periods, from modern deposits, through the Miocene and Eocene strata, chalk, and lias, down to the true coal-measures, and from localities in Bohemia, Moravia, and Silesia, Galicia, Hungary, Transylvania, the Military Border, Croatia, and Esclavonia, and along the Alps, from the Tyrol and Vorarlberg, Salzburg, Upper and Lower Austria, Stiria, Carinthia, Carniola, and Dalmatia.

The collection of Specimens of Fossil Fuel was collected by the Imperial Geological Institute at the request of the Austrian Central Exhibition Committee. Letters were issued to the owners and superintendents of all the mines in the Empire, and the Institute was thus largely supplied with specimens, so that the exhibited collection fairly represents this department of Austrian mineral wealth.

The number of tons of coal raised in 1860 in the different provinces, as represented in the list which accompanies the specimens, is—

	Tons.
Bohemia	692,840
Moravia and Silesia	719,300
Galicia	56,000
Hungary and Banat	297,100
Transylvania, Military Border, Croatia, Slavonia	10,180
Austria	121,260
Styria	112,080
Carinthia	36,450
Carniola	7370
Dalmatia	6500
Total	2,059,120

The total amount statistically registered being about 3·5 millions of tons.

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

COTTESWOLD CLUB.—*July 23rd.*—The meeting took place at Frocester Station, whence the members proceeded to the famous section of Frocester Hill locally known as the Old Quarr. On arrival there, some labourers, under the direction of Mr. E. Witchell, cleared away to some extent the rubble which covers the thin "ammonite-bed." Frocester Hill affords one of the finest exposures of the Inferior Oolite in the country, and yields to research an abundance of the choicest fossils; so that some of the most distinguished Continental *savants* have visited it for comparison with the foreign Jurassic sections. It comprises the "cynocephala stage" of Dr. Lycett. The party were soon at work on the "ammonite-bed," and, after exhuming numerous characteristic specimens, struck off toward Peaked Down to examine the sands, which are of considerable thickness there. Geology and archæology as sister sciences so blend together at certain points, that it is difficult to apportion the peculiar province of each; our Cotteswoldians, however, came to a halt at Coaley Hill tumulus, which, like a weir across a stream, effectually divided them into two currents of geologists and archæologists—the latter plunging with professional ardour into the cairn and its traditions; a few, we were told, even dexterously wriggled their way into the bosom of the tomb itself; while the geologists, with that gravity which befits students of the "exact sciences," carefully wended along that line of neutral ground yclept the Upper Lias sands by the many, but which has been stripped of its nationality by some, and associated with the Lower Oolitic group. Their route lay across a thickness of about 200 feet of these peculiar sands, and brought them by way of Longdown and Peaked Down to Dursley, where dinner-hour brought the scattered members together at the Bell Hotel. Some papers of interest were read: 1. By Dr. Lycett, of Scarborough, "On *Ammonites opalinus*;" 2. By Mr. John Jones, "On the Land and Fluviatile Mollusca of the Gloucester District." The latter is an elaborate paper, containing the observations of the author during a period of twenty years, and is of great value to those pursuing that branch of natural history.

Dudley Geological and Scientific Society.—It is with much pleasure we convey to our readers the agreeable information of the establishment of a Geological Society in the classic neighbourhood of Dudley, where many of the finest organisms of the Silurian rocks have been exhumed. This well-known locality once boasted a valuable collection of fossils, and had also a society which did good work, for a short time, in developing the geological features of the district; but the museum has long since passed from public view, and the society has become defunct. We observe that the newly established club is not merely a resuscitation of the society once existing, but is cast on a much more comprehensive plan, and will include all that belongs to the natural history and antiquities of the midland counties, but particularly that part which lies within easy access of the old town of Dudley. The inaugural meeting of the society was held on the 15th of August, under distinguished local patronage; and a very interesting day must have been spent on the occasion. The party, after a public meeting and luncheon, at which Lord Lyttelton presided, visited the Silurian beds at the well-known Wren's Nest Hill, and made a rapid survey of the present limestone workings. After this they had an opportunity of inspecting the ruins of the Castle Hill and the Priory grounds; and in the evening, through the kindness of the Earl of Dudley, the vast caverns beneath the Castle Hill were brilliantly illuminated. It may be mentioned that a canal runs through these vast subterranean workings, and well-kept paths enable visitors to walk through the caverns with perfect ease. The banks of this canal were lighted up with innumerable candles, as were also the vast arches in various parts of the caverns; and the strange aspect of the boatmen as they plied their rafts along this Stygian pool, and the weird figures of attendants in uncouth garb, who lit up the largest arches and caverns with coloured fires, presented an extraordinary scene. Mr. F. Smith, his lordship's agent, gave the party a full description of the caverns, and of the mode by which the limestone has been excavated.

The society already numbers upwards of 200 members, including many well-known scientific men, who have rendered good service to science by their local investigations. We augur well for the new society, if its promoters only follow up their successful starting, by doing really practical work. We have no doubt it will soon become a useful institution for the important district over which its operations will extend.

NOTES AND QUERIES.

A Fossiliferous Cave at Meliha.—Another of these interesting storehouses of the relics of the Pleistocene age was brought to light last week through the researches of Captain Spratt, R.N., whose scientific labours in connection with the geology of these islands are so well known and appreciated. Vague rumours prevailed some years ago of the existence of a cave of this kind at Meliha, which coming to the ears of the late lamented Sir William Reid, he directed the attention of Lord Ducie and Captain Spratt to the spot, but nothing then could be found. A fossil hippopotamus tooth in the possession of Signor Pace, an Italian gentleman residing here, said to have been obtained from Meliha, led Captain Spratt to institute closer and stricter inquiries, and, while in the Bay of Meliha with his ship a few days ago, he succeeded in finding the remains of a fossiliferous cave at a short distance from the village church. It had been, unfortunately, almost destroyed to make way for a road, and the rubble used to fill up the interstices of a wall; but sufficient remains of hippopotamus bones and teeth were dug up to indicate its having been of a similar character to the Meilach cave near Crendi, regarding which we lately published some interesting particulars from the pen of Dr. Leith Adams, of the 22nd Regiment.—*Malta Times*, July 17.

Human Remains.—In June, 1747, the body of a woman was found six feet deep in a peat-moor in the isle of Axholm, in Lincolnshire. The antique sandals on her feet afforded evidence of her having been been buried there for many ages. Can any of our readers give information as to what has become of these relics, and whether any other very ancient human remains have been found in the district?

In a turbary on the estate of the Earl of Moira, in Ireland, many years ago, a human body was dug up a foot deep in gravel, covered with eleven feet of moss; the body was completely clothed, and the garments seemed, it is said, to be all made of hair. It would be highly desirable to get information respecting such finds, especially whether they have been preserved in any collection.

Deer in England.—Mr. Richard Howse, in the committee's address, p. 190, Trans. Tyneside Naturalists' Field Club, vol. v., p. iii. (1862), *i.e.* from the paper read in 1861, makes the following statement:—"On a recent visit to Newcastle, Professor Owen stated that the former was the first and only proof he had seen of the occurrence of the *Moose* in the fossiliferous deposits of England." As the word *Moose* alone here might lead to a natural mistake, we think it right to observe that we believe the specimens referred to belonged to the Elk or Moose (*Cervus alces*, Linn.). They do not belong to the Wapiti (*Cervus canadensis*).

REVIEWS.

The Laws which regulate the Deposition of Lead Ore in Veins, illustrated by the Examination of the Geological Structure of the Mining Districts of Alston Moor. By W. Wallace. London: Edw. Stanford, 1861.

It is some time since we received the handsome book produced by Mr. Wallace on the mineral district of Alston Moor, and in the interim many periodicals have passed eulogiums on it, which it well deserves. The volume in our hands has not however been laid aside, but in truth it involved careful reading, and that involved time—an article not always plentifully at our disposal. It has been thus only from time to time that we have fairly read and examined Mr. Wallace's labours, and our meed of praise, therefore, is not the less valuable from its being tardy. Even now other urgent demands upon our space restrict our notice to the shortest limits; but at a season when mining and mineral products are displayed so prominently before the world, and men interested in commercial pursuits are congregated in London from all parts of the world, it is only right and just to bring this excellent literary production under their notice. The opportunity, therefore, is seasonable. We are informed the book has already had a good sale, and we hope our remarks may cause an additional incoming to the exchequer of the author, who must have been at a considerable expense to have so profusely illustrated his work with the clearest and finest chromo-lithograph sections, plans, and maps.

To collect, arrange, and harmonize the experience of many generations on any subject is indeed an arduous and difficult task, and it has been well remarked that it is peculiarly so with everything relating to metallic veins and metalliferous deposits. In the first place, the information required is too often either wanting or defective, and the ideas of miners, commercial and scientific men all vary, in many degrees, according to the point of view from which the aspect is taken. Large profits may be derived from a poor mine when the price of metal is high, and rich mines may not pay when prices in the metal market are low. Large profits might accrue from lead-ore scattered in the sides of a soft vein, while a far greater amount of metal would not cover the expense of extraction from a hard one; and all these classes of circumstances naturally affect the views of those who are practically engaged in mining and tinge the opinions they offer. Fortunately for us, this debatable ground is not our territory. From the geological standpoint in the present case, we look to that more interesting topic, how the mineral veins were produced, how they exist in the strata of the earth's crust, and those other natural phenomena they present, which lead to a knowledge of their past history and their present conditions. Mr. Wallace begins his book at the right end. He gives us first six chapters on the formation and geological structure of the mining districts of Alston Moor, in which he treats of the laws which have regulated the deposition of the mountain limestone in Great Britain, the elevation of the rocks of Alston Moor to the position they now occupy, and the laws which have regulated the denudation of the country, the laws of the formation and direction of veins, and the formation and direction of east and west veins, with descriptions of the principal; and then he enters into special details of the Alston Moor and Coal Cleugh cross veins, and the Quarter Point veins of Alston Moor.

He next gives us ten chapters on the laws which regulate metalliferous deposits, as illustrated by an examination of the lead veins or lodes of

Alston Moor. In these he argues, that as lead ore is not deposited throughout the whole extent of the veins, they have not always been filled with minerals or metallic substances; the deposition must therefore be the result of certain antecedents ; and he infers that the laws which have regulated the distribution of metallic ores may be different from those relating to the origination of the metal. Two theories have been proposed to account for the origin of ore-veins : the one supposes them to be segregations of metallic particles from the surrounding rocks, the other regards them as deposits by sublimation from great depths and connected with volcanic influences. It is certain, however, that the laws which have regulated the distribution of ore in veins may be of a very different character from those connected with its origination ; the former may be mechanical, the latter, if metals are substances compounded from certain elements unknown in a separate state, must be chemical. If they are simple substances which have risen from the interior of the earth as gaseous emanations, then the accumulation of the ore in certain portions of the veins may have taken place after its deposition sparsely throughout the whole extent of the fractures in the rocks ; if the metals are derived from rocks in which their existence cannot be detected, then the compounding and localization of the ore may have been effected contemporaneously. The experiments of Becquerel and others have shown that metals in solution may be crystallized and combined with other substances by electro-chemical agency, forming minerals exactly similar to those found in nature ; but interesting as those experiments are, they render no assistance to the practical miner in guiding him to the deposits of metallic ores so irregularly distributed in the veins ; they relate more to crystallography and mineralogy than to practical mining, for crystals of various kinds are found where none of the metals exist. No kind of mineral in the veins at Alston Moor varies so much in quantity in different parts of the same stratum as lead-ore. It is found plentifully deposited with quartz, carbonates and sulphides of lime and iron, fluorspar, barytes, oxides of iron, black-jack, etc., and it is frequently absent in the same stratum when the veins contain large quantities of some one or other of these minerals ; hence its deposition is not dependent on the presence or absence of any of those minerals, and it is evident that whatever caused their deposition has not prevented the operation of those causes which regulated the deposit of lead-ore. The variation in amount of lead-ore in the same vein and in the same stratum or kind of rock being greater than that of any other mineral, the law of such variation is more likely to be ascertainable in its case than in any other. In Alston Moor the veins have been most productive in situations furthest removed from plutonic action ; the richest deposits having been effected in the upper part of the mountain limestone, where no igneous rocks are found either in the form of dykes, or of sheets intermingled horizontally with the stratified rocks. The lower part of the strata in that district includes a stratum of basaltic greenstone as well as a basaltic dyke, but the veins generally have contained very little lead-ore, where these rocks have formed their sides or walls—a circumstance, however, we should think might very probably be sometimes due to the sublimation or driving off of the lead by the heat of the injected lava in the cases of volcanic dykes.

So far as the Alston Moor district is concerned, Mr. Wallace thinks there is nothing to support the theory that the lead is due to exhalations from below, or to matter injected in a fluid state among the consolidated sedimentary rocks. The nodules of carbonate of iron, so often found arranged in layers of beds of shale, have generally undergone some degree of contraction in the interior ; often the exterior has been consolidated to a degree sufficient to limit the shrinking of the central parts of the mass. Into these cracks sulphides of lead, zinc, and iron, copper pyrites and certain other minerals of a different class have not unfrequently been introduced. In such cases it seems exceedingly improbable that those substances could be derived from exhalations from beneath. There can be, on the other hand, no doubt that their component parts have come by infiltration from without. It is also evident, that these bodies or their component parts were in a soluble state when they entered the cavities formed by the cracks of the nodules. Infiltrations occur also in the cavities left by the decomposition of fossil shells, and in those formed in various other ways. At St. Agnes, Cornwall, crystals of feldspar have been removed from elvan and replaced by peroxide of tin. "Instances of this kind," Mr. Wallace says, "are of a deeply important character, and are almost conclusive that metals or the elements of metals are diffused, perhaps in varying proportions, throughout the whole mass of all kinds of rocks. They indicate, probably, the existence of metals in veins as the result of combinations and changes which cannot be always, if indeed ever, *directly* connected with volcanic influences; and although the quantities of metal infiltrated are infinitesimally small when compared with deposits in veins, they may be regarded as *instantiæ crucis*, indicating, at least, the direction which the inquiry ought to take." Taking up the consideration of the conditions connected with the Rampgill vein, where the lead ore occurs in the greatest intensity, he notices that the richest portions are at the intersections of the Quarter Point veins, and comes to the conclusion that the functions of the conditions differ from each other, those connected with the rich portion being favourable to a circulation of water, the other not so. He then proceeds to discuss the laws regulating the descent of water below the earth's surface, and the deposition of vein-minerals, such as carbonate of lime, and barytes, in the open spaces in veins. Then the connection is traced between the laws regulating the descent and circulation of fluids and the deposition of lead-ore in the veins of Alston Moor. He next follows up the connection between the laws of hydrous agency and the deposition of lead-ore in veins on the east side of the Trent river, those traversing Mountain Middle Fell, and elsewhere. This is followed by investigation of the connections of the laws of hydrous agency with the deposits in the "lower beds," and, considering that metallic ores in veins traversing clay-slate and granite, must be equally subject to the same agency, he devotes a chapter to them.

Dwelling on the facts, that the richest mines are in decomposed granite, and that metallic ores are sometimes found in the joints of that rock, as is the case in the long-celebrated Carclase tin-mine, and indeed throughout the whole granite district of St. Austell (Cornwall), he remarks the correspondence as being very striking between the more decomposable parts of the Great Limestone in Alston Moor, and the decomposable granite, in that instance being associated in the former case with pure and rich deposits of lead-ore, and in the latter with tin-ore of excellent quality; and comments on the effects of atmospheric exercises as exhibited in all mineral veins generally, and in gold and silver mines more especially, singling out the remarkable mine of Potosi as a prominent instance of the latter. He notices also the association of dissimilar rocks, and considers that in some instances the intruded rock may have been the source from which the metallic ore has been derived. In his concluding remarks he considers that from the evidence brought together it would appear that either lead or some basifying principle must enter in varying proportions as a component part of the rocks of the Alston Moor district, or some still more elementary substances, from which it is formed by the laws of chemical combination as yet unknown; and that there is no reason why lead and zinc may not be at the present time in course of deposition wherever the conditions are favourable. In the Tyne bottom mines there is reason to suppose that the lead-ore has been deposited on the flats at a comparatively recent period, and long posterior to the glacial epoch. Such is a summary of the principal features of Mr. Wallace's book,—a work characterized by great pains and careful attention, and which we can but think must prove highly useful to those engaged in this special class of inquiries.

On the Failure of Geological Attempts in Greece, prior to the Epoch of Alexander. By Julius Schvarcz, Ph.D., F. G. S., Corr. Mem. Ethn. Soc., etc. etc. 4to. London: Taylor and Francis. 1862.

In the 'Geologist' for March, 1862, we had the pleasure to call the attention of our readers to some works on Geology and Ethnology which had been published by Dr. Schvarcz in the Hungarian and Greek languages. These works, translated into the English language with a mental force and vigour which almost makes our geologists and biologists blush for their laurels, naturally attracted much attention and admiration, which was heightened when the author, two months ago, appeared personally before an English public to contribute his reflections on the progress which Geology and Ethnology had made in classical times, prior to the development of that school of biological thought, which was sanctioned by the auspices of Alexander, and promoted by the researches of the Stagirite.

Such considerations as these, though condemned by the healthy English mind of John Hunter,* have led Dr. Schvarcz to succeed in proving that many of the beliefs of the early Greeks rested rather on a vague knowledge of geological facts than on any subjective excogitations, working within and by the consciousness of Greek thought. The eternity, or at least the long continuance of the ἰδέα, that other races pre-existed to the historical self-styled *autochthones* of Hellas, is proved by Dr. Schvarcz's facts. The withering rebuke which he gives to the school of thinkers who are self-styled "practical men"—notoriously the most unpractical and the most impracticable with which a thinker can deal—we transcribe *verbatim*. The philosophers of the Socratic school certainly make a sorry figure when limned by Dr. Schvarcz, who has painted them in the darkest colours. The true spirit of a conscientious biological positive philosopher is however displayed by him, in the subjoined eloquent passage:—

"*Men are to be met with in our own days whose mental structure exclusively fits them to observe from moral points of view,—men who are unable to rejoice at cosmical or metaphysical acquirements—who ask, pace for pace in their learned deliberation, for an application to practical advantage. To speak with men of this description upon scientific matters would*

* "People who stand up for antiquity, and want to carry all knowledge as far back as the first teachers, which knowledge really does not belong to them, instead of raising their character rather injure it. . . . If the ancients really understood any piece of knowledge that we look upon as modern, and if their account be really so dark and imperfect that there is no understanding them without previously understanding the subject, it shows that they were much more stupid in not transmitting to us intelligibly what they knew, than if they had not understood the subject at all."—Hunter, J., 'Essays and Observations on Natural History,' edited by R. Owen, 8vo, 2 vols., London, 1861, vol. i. p. 369.

prove to no purpose, for such a people are born so that they do not feel the needs of science. They will never be convinced that the aim of the latter, when it looks for the distances of planets, is nothing else than to bring us to comprehend both our position and lot in space ; *they will never be convinced that a veritable scholar may study such things merely, therefore, because he desires to know them ;* on the contrary, their belief was, is, and will remain for ever, that the student who proceeds this way must either pant for some personal renown, or must be a madman, or else will end by putting his brains upon the rack about a method of connecting the celestial bodies with the earth by a telegraph ; in short, their belief will always be that the student who deals with these subjects, if not ambitious and not crazed, must have a mind to make merchandise of them, and so to treat them that they may yield to him a profit. They will naturally give a partial and defective definition of the 'profit' every earnest student of science is working to obtain, a profit which differs in every essential part from the one which is to their minds the only road to human greatness. To this class belonged Socrates, and him from whom we learn his historical engagement better than from Plato, Xenophon himself.

"The ancient Greek natural philosophers were reproached by Socrates with being unable to produce, if occasionally required, wind or rain, etc., however they strain their wit in refinements about the origin of all these phenomena. According to the judgment of this 'wisest of all mortals,' it would be sufficient to cultivate astronomy only as far as it may serve to the recognition of the parts of a year, month, or day ; and this knowledge might be obtained through a conversation with town-criers and steersmen. To go further than this, to extend the ken of our intellectual powers to the planetary and cometary orbits, he deemed not only superfluous, but even dangerous. From geometry, likewise, he permitted only so much to be acquired as might be necessary for the affairs of purchase, bargain, vendition, and for the surveying of fields. To stray into problems of a more complicated nature would consume human life in vain.

"We may thus regard him as a mere advocate of practical life, who spent his own in analysing the errors of almost all classes of human society, and incessantly pursuing the phantom of what he thought might be termed 'virtue,' without ever being able to feel, in spite of his 'spiritual midwifery,' any nearer approach to the perception of wherein, after all, this 'virtue' consists.

"We may regard him as a mere political agitator, who never attained to the dignity of a true moral philosopher ; for the latter will, when continuing the direction pointed out by his own frame of mind, never assail those who cultivate the other great branches of intellectual life, the metaphysical or physical. On the contrary, he will esteem such a distribution of force necessary. His dull objections against cosmical philosophy, uttered in the shops of carpenters, shoemakers, saddlers, and helmetmakers, added the stamp of quackery to his unquestionable rudeness ; his economical receipts, as in the case of Ceribus or of the steward, added to his repute nothing common to that of men like Anaxagoras. Honest enthusiast, in other respects, as he was, he would have expressed the memory of the most distinguished adversaries of Greek cosmosophy without cankering the coming civilization of whole nations. Yet his scholars, Plato and Xenophon (the former being incomparably greater than his master), stirred up his manes, and rendered him hateful and despicable to the noblest class of men, to natural philosophers."

The progress of positive biological knowledge was thus impaired by the influence of moral poetry amongst the Greeks. "It was the pressure exercised by the hexameters of the 'Iliad' and 'Odyssey,' of the 'Homeric Hymns' and 'Epigrams,' on the Greek, which retarded chiefly the progress of cosmical investigation. As the English their Bible, so venerated they the Homeric Poems: it was more than a mere fashion to quote lines from them: and whenever the questions of the day excited alarm, the lettered of Megalopolis and Corinth, of Argos and Milet, took not less eagerly refuge to their authority than some grave farmers of Norfolk or of Aberdeenshire to theirs for the sake of getting a quick delivery about the *Gorilla Gina* and the *Ægilops ovata*, the Niam-Niam and the 'flint implements in the Drift.' To the same category belonged the Didactics of Hesiodus. Their perusal proved still more dangerous for youth in consequence of their being intended to substitute the cosmogonies of observing natural philosophers."

Even the Peripatetic school is castigated by Dr. Schvarcz. Speaking of Aristotle, the man who did more for Zoology than any other prior to the time of Cuvier, in whose works "l'histoire de l'éléphant est plus exacte que dans Buffon'* he says, "It was unfortunate for the history of the efforts made by Indo-German races to arrive at some recognition of the true scheme of the universe in space and time, that this man had an aversion to geology, or was too overwhelmed with researches in other branches of knowledge—the man who exhibited the best-suited mind amongst the Greeks for natural investigation, and who, freed from every prepossession, admitted even the myths to be veiled explanations of cosmical phenomena."

In some classical authors, however, a glimpse at positive facts, inductively obtained, redeems the character of the ancients for observational acuteness.

"Ctesias the Cnidian ascribed, in spite of all these pretended observations, the black (dark) colour of Hindoos, not to the action of solar rays, though the latter have been accused by Æschylus, Herodotus before him, by Theodectes of Phaselis, and a great many authors after him, of swarthening the skins of nations; but he ascribed it to nature, that is, he established a scheme of 'permanence of type.' . . . Even in our own age, it appears to be now generally admitted that unity of species does not involve unity of origin; in what, then, regards the relation, in the Greek view, of human races to each other and the other groups of the animal kingdom, we must refuse every startling generalization; for *I am firmly of opinion that the whole question of the origin, development, transmutation, or extinction of human races, as dealt with by the greater part of ethnologists, is of a negative character, and has arisen from the reaction against a theological proposition.* Had sacred tradition not awakened, say, the philosophical theme of the origin of mankind from one single pair, scientific investigators would have never accumulated around those points of view so many data of observation. . . . The circumstance alone, that those philosophers who lived in the vicinity of volcanos always adhered to the doctrine of a final conflagration, and those who lived near the sea always to that of a final cataclysm, removes any analogy to the religious appreciation of the 'signs of the times' as given in sacred history. . . . Anaxagoras the Clazomenean, being interrogated whether the Lampsacene mountains would ever become converted into sea, replied, according to the testimony of Diogenes Laertius, 'Yes, if time lasts long enough.'"

It would be impossible here to notice the philosophical and metaphysical facts which Dr. Schvarcz has adduced, in favour of the cognition, by the

* Cuvier, 'Discours Préliminaire sur les Révolutions de la Surface du Globe,' 8vo, 4th edit., Paris, 1834, p. 154.

ancients, of some geological ideas. The work is throughout marked by a manly, vigorous, style of thought, which alone would entitle the author to take the prominent place amongst Europe's most philosophical thinkers he has assumed. In the confidence that future researches will speedily result from his prolonged attempts to pierce into the hidden fountains of human thought during past ages, we cannot better express the pleasure and admiration we have felt while reading the work than in this necessarily brief and imperfect notice of Dr. Schvarcz's volume.

Volcanos, and the Character of their Phenomena. By G. Poulett Scrope, Esq. London: Longman. 1862.

There are only two ways of reviewing a book, either thoroughly or briefly. To review Mr. Scrope's book properly would not only occupy the space of a number, but it would be superfluous on our part; for, as without exception, it is *the* standard work on the subject, every geologist who studies volcanic phenomena *must* have it. Mr. Scrope's views are well known. He traces in all the mass of evidence accumulated the proof of the general uniformity and simplicity of the phenomena of which volcanos and the volcanic formations are the expressions. Opposing Humboldt's view of their "isolated, variable, and obscure character," he mostly labours to show, that in every quarter of the globe the eruptions that have taken place are characterized by the same repeated splitting of the earth's crust in fissures, and generally accompanied by earthquakes and other indications of the swelling and heaving of subterranean effervescent matter, the same explosive outbursts of steam and vapours, throwing up liquid drops and cellular fragments of wholly or partially fused mineral substances or lava, or expelled in jets or streams, which flow or spread over considerable areas, or accumulate in bulky masses about the eruptive vent according to their degree of liquidity or gravity, and an examination of which discloses everywhere the same basalts, greystones, or trachytes, composed of the same minerals in varying proportions. He points out everywhere the same composition and structure in volcanic formations, from the smallest cinder-cones to the greatest and loftiest mountains, presenting the accumulated result of a long series of successive eruptions; the same general quaquaversal dip of their component beds of lava and conglomerate from the central heights, as formed by successive outpourings and successive showers of ejected materials; the same hollows drilled here and there through the axes of the mountain-masses by the force of exploding volumes of steam; and, finally, the general parallelism over the entire surface of the globe of the chief trains of volcanic vents as if the fissures through which the eruptions find their way outwardly were owing to the lateral drag occasioned by the upheaval of some contiguous superficial portion of the earth's crust overlying a stratum of intensely heated and highly elastic matter, the tension of which, through increase of temperature, had more or less overcome resistances exposed to its expansion.

Fig. 1.

Fig. 3.

Fig. 2.

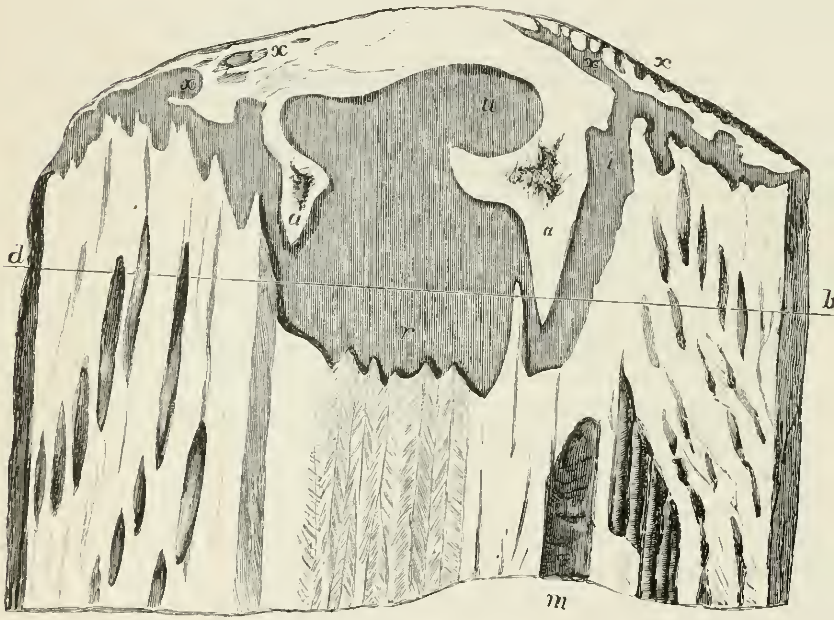
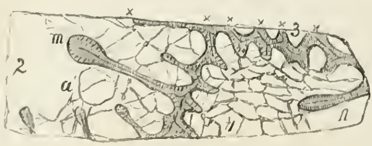


Fig. 4.



BARRETTIA MONILIFERA.

1. Reduced figure of a group of three individuals. 2. Longitudinal Section.
3. Tangential Section. 4. Transverse Section of Fig. 3.

THE GEOLOGIST.

OCTOBER 1862.

LIKES AND DISLIKES.

We are told that Lord Chatham once excused himself for not paying due attention to the speech of a political rival by saying, that he felt that man was responsible to the Creator that his time should not be wasted by hearing discourses which neither conveyed profit or amusement to the hearer, nor honour and dignity to the speaker. We were reminded forcibly of this anecdote by reading in our esteemed contemporary the 'Parthenon,' a few weeks ago, a paper entitled "Likes and Similitudes,"—a title very like that of an Adelphi farce.

It has been observed by metaphysical writers, that every object in the world must be either *like* or *unlike* some other object, and consequently, there can be no difficulty in instituting either a comparison or a contrast between any two things. For those readers then, who, like the zoologists ridiculed by Forbes, have a vivid perception of analogy, but not of affinity, as well as for that far more numerous class who can but perceive differences, without being able to decide whether they are dependent upon analogy or affinity, the perusal of "Likes and Similitudes" will afford insipid and innutritive mental repast, akin in nature to that which regales poetic minds entranced over the pages of the 'Sentiment of Flowers' or 'The Language of Plants.'

There may be writers who might find a congenial banquet in an account of the gambols of a malevolent monkey, or in the descriptions of the frauds practised on some of those bygone geologists whose works, applied in sheets by paste, now line the insides of our travelling trunks. But to those who regard Geology and Zoology, and their kindred sciences, as the pillars of physical truth, who regard scientific exactitude as an object of reverence, and who inculcate scientific methods of thought as the most noble, the most worthy occupation of man's mind, the perusal of these papers will afford a sentiment of disgust similar to that which the pious Bunsen felt when criticizing the predecessors of Schelling :—

> "———— preaching dreams
> Like hierophants before a gaping mob."

What good can it be, when the bulk of our masses are in ignorance respecting the most elementary facts of geology, to waste the space of a popular and excellent periodical by alluding to the fact that some obsolete writer has described the "ammonite as a silly insect with black spots"? Far better it would be for a sincere biologist,—not one who merely picks out the "pretty bits" of science,—to explain the structure of an ammonite, to define the various subgenera and the wonderful modifications of form which ammonites exhibit, or to attempt to do the useful work of unravelling the obscure synonymy of the genus. To neglect the grave problems of science merely to tell us that a chrysalis looks like a "buttoned-up cabman upside down," or like something else right side up, is indeed to reverse the practice of Wamba the Witless in Scott's novel, who, although passing his time of peace and idleness in jesting and folly, could wield a powerful sword when the danger of his master was imminent.

One only of our modern writers seems to have had the facility of combining witticism and caricature with the more serious work. This was Edward Forbes. But the harmless waggery and real wit, which flowing from the genial pen and facile pencil of one who had done such good service, might be tolerated. No other wit, either of his own day, before his time, or since, could dare to do the same; or if he dared, would only make a bitter failure of his rashness. In the hands of puny men such effort becomes the badge of mental weakness, and diminishes into reprehensible vulgarity. In Forbes's inimitable sketches, wit, humour, and point tell out in every stroke; but it was only the genius of the artist-wit that saved the *savant* from condemnation for the practice. It was *the man* we permitted to take such licences in his scientific works; but *his* jokes were *added* to his chapters, and he never made a joke of his real, good, earnest work.

No scientific problem would be the better for being grinned at through a horse-collar; and the constant joking about matters of grave import forcibly corroborates the truth of the celebrated aphorism of Lord Bacon,—"Homines derisores civitatem perdunt."

The facile pen of our author, glib in finding that anything in science is like anything else, runs smoothly and superficially over the whole animal and vegetable kingdom. We are told that an Entomostracan,—

"*Sida crystallina*, is easily transformed into a costermonger by giving the creature legs, a pipe, and a basket of greens."

We were not previously aware that legs, pipes, and cabbages, were the only predicable characters dividing the human race from water-fleas. It is, however, but too evident that the writer is unacquainted even with the most elementary scientific facts. Thus, in the first paper, *Tarsius Bancanus* is spoken of as being man's progenitor. Compare the gorilla's brain with Tarsius's brain! Has the author of "Likes" ever read Burmeister's monograph? has he ever seen the paltry little lemur? Again, in the second paper, he writes—

"The *Acidaspis Keyserlingii*, a Silurian Trilobite figured by Barrande (Syst. Sil. de Bohême, pl. 36), bears a remarkable likeness, when *I give him feet* and arm him with a spear, to a Polynesian savage."

We are too slow to see the likeness, but we are far from wishing to tempt the author of "Likes and Similitudes" to offer us any of those artistic examples of his dementia with which his manuscript was probably suitably illustrated; but he is evidently possessed with a pungent idea that there is some occasional connection between some individuals of the human race and the family of crabs, for he adds—

"*Pemplis Suessii*, a crustacean of higher class, met with in the New Red rocks of Germany, figured by Von Meyer, may be claimed by Mr. Layard as an Assyrian king in an eruptive state."

The meaning of this sentence fairly baffles our limited powers of comprehension. Why Mr. Layard should feel anxious to possess an Assyrian king whose skin may be unhealthy, or who is in the process of volcanic excitement, we avow ourselves unable to fathom.

We all know the unfortunate mistake a certain lady is reputed to have made by looking *at* her dictionary; the author of "Likes" has achieved an equally unfortunate result by *not* looking at his before he wrote—

"The curious wing-finned fishes found in the Old Red Sandstone of Scotland, belonging to the genus *Pterichthys*, which have been so cleverly described by the late Hugh Miller, were long before known to the quarry-men as petrified cherubims; for the attachment of the fins to the neck-plate gave them much the appearance of those chubby cherubs with fluttering wings, so often carved by village cutters upon grave-stones."

We confess this anecdote is new to us; but we were fully aware of the fact, that the fragments of the large crustacean *Pterygotus* were termed "seraphim" by the Scotch quarry-men, by reason of the "wing-like form and feather-like ornaments of the hinder part of the head, the part most usually met with" (Lyell, Manual, p. 419), and the words *Pterichthys* and *Pterygotus* having the four first letters in common, is perhaps sufficient excuse for the confusion between a ganoid fish and a crustacean.

Does not the Welshman in Shakespeare's Henry V. come to the reader's mind—

"In the comparisons between Macedon and Monmouth, the situations, look you, are both alike. There is a river in Macedon, and there is also moreover a river at Monmouth; it is called Wye at Monmouth, but it is out of my prains what is the name of the other river; but it is all one, 'tis like as my fingers is to my fingers, and there is salmons in both."

It is too much to expect an æsthetic writer who knows Tennyson better than Morris's Catalogue, to "creep servilely after the sense" of common thinking men.

Our author tries the marvellous:—

"Many fungi have affinities to animal forms. Some African forms of these remarkable plants, referable to the genus *Boletus*, have been compared, in size, colour, and shape, to sleeping lions. With such resemblances, it may be imagined that early botanists did not overlook the opportunity of linking them with the supernatural. One amusing instance is the species of Starry Puff-ball (*Geaster*), figured by Sterbeeck in his 'Theatrum Fungorum' (1675) as a family party of Anglo-Saxons going to sea in a boat made out of the mycelium of the fungus."

May we ask, what is the supernatural instance here alluded to? Is it the "delusive shilling sail" of the Anglo-Saxons, or is it the sleeping lions; or are mushrooms allied to lions, or to ghosts, or both to either, or what, or which? We know that witches had intercourse with the supernatural world, and went to sea in tubs; perhaps that is what is meant, but we should have been told so. We must avow ourselves on this occasion of the same opinion as Lord Dundreary on another, "that there are some things no fellow can understand."

Our zoologist, whose "study has been to describe organisms by the depths of scientific research, or to seek out the more playful phases of terrene life," sinks rapidly to the congenial level of the dirt-pie, and tells us, "The forms, odd and absurd-looking as they are, into which plastic clay and silica have been moulded, are replete with instruction. For the resemblances which at first seemed to assimilate classes and genera do, in fact, strengthen divisional lines and increase the value of species."

Perhaps the future attempts which our enthusiastic contributor may make to solve the mystery of the Origin of Species, may be materially aided through the means of a handful of London mud. Perhaps even oyster-grottos or card-houses may have their deep mystic significations on the problem, and give the "stamp of verity and truth" to the "tracings made for the amusement of young naturalists." In the meanwhile, to the tender mercies of those zoologists who have worked out the *Polyzoa* we commend the following description:—

"Among the oddest, though at the same time the most graceful, of natural patterns, may be reckoned the aggregated cells which make up the homes of those low-class molluscan animals, the Polyzoa-Bryozoa, or moss-corals, as they are commonly called. A living mass of this moss-coral, viewed through a microscope, looks like a screen of carven stone-work, with openings where light is needed. Keeping watch at one of these holes, presently we see a tiny beak of transparent jelly peeping through; and, if the coast is clear, rosy-tipped fingers of the same exquisite material are pushed out, to catch and entangle the floating atoms in the water. Some openings or cell-doors are hooded in rather a comical way, and each one has a living tenant, who at times 'stands at his door in a diamond frill,' and fishes for his dinner. One of these cellules is seen to be hooded like a calceolaria flower; another uplifts little childlike arms; a third has perforated ears and a very mousy look."

How *the ears* of a Bryozoon can be perforated—even, if it had any, how it could be mousy—we fail to perceive. To pick a last example of the many absurdities which still remain, we are told that "the head of a small Clupean fish from the Caribbean Sea presents a remarkable resemblance in facial contour to the present Emperor of the French." Falstaff compares himself to a "shotten herring;" but we have too much respect for the Anglo-French alliance to endorse such an "unsavoury simile" in respect to Louis Napoleon.

We like real fun and enjoy real wit as much as anybody, but we dislike to see science "made funny" for the sake of the so-many shillings a column which the proprietor of a magazine pays, in confidence of the ability of his contributor to send him good matter. We dislike to see science deliberately degraded.

We are sorry to think that 'Likes and Similitudes' emanates from the pen of an author who sometimes dates his lucubrations from the Geological Society.

ON THE METAMORPHOSIS OF ROCKS IN THE CAPE TOWN DISTRICT, SOUTH AFRICA.

By Dr. R. N. Rubidge.

I gave, in a paper in the February number of the 'Geologist,' a general view of the facts in the geology of this country which have led me to believe that the metamorphosis of rocks is due to a slow and gradual change in their constituents; of which change water is one of the chief agents, and the internal heat of the earth not a necessary adjunct.

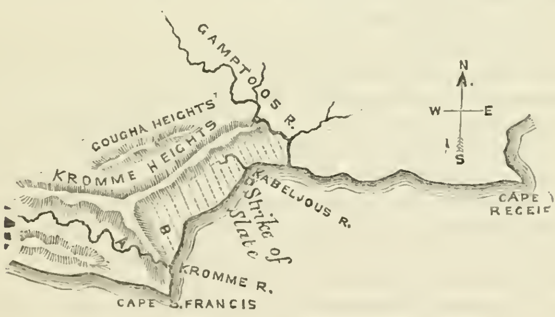
I now propose to describe more particularly those relations of the quartzite with the palæozoic rocks, a careful examination of which has rendered necessary an entire reconstruction of the geological map of the country. That map, published in the Transactions of the Geological Society, was the work of an able man, and the evidence on which the Devonian (Upper Silurian, Bain) was separated from the Clay-slate formation was (so far as I have been able to verify it), I believe, such, that he would not have been justified in coming to another conclusion by any generally admitted principle of the science; for this reason, I invite the criticism of European geologists on my facts and inferences, and their aid in solving many difficulties which still remain unexplained.

I stated in my former Paper that the plains and lower hills and valleys of the coast region, extending from Cape Town to the mouth of the Fish River, were formed of blue slaty and sandy rocks. These were all referred to one formation by Lichtenstein.

Dr. Krauss, an eminent botanist and geologist, states that he made repeated sections of the country, from the coast to the Karoo, and always found the clay-slate (Thonschiefer und Grauwackeschiefer) occupying the plains and valleys, and the quartzose sandstone or quartzite (Bunter-Sandstein) the mountains. On Zwartkops heights and the Von Stadens river bergen, he remarks this was notably the case. Dr. Atherstone, in a section through the district of George, could find no reason for separating the clay-slate from the Devonian. Mr. Bain agrees with these authorities as to the identity of the slates as far eastward as the mesozoic estuary of the Gamtoos river. In his map he shows the clay-slate, interrupted (as also mentioned by Krauss) by masses of granite, and surmounted by sandstones, extending from Cape Town to the edge of the mesozoic rocks,—a point corresponding to the Kabeljouw river's mouth in the sketch.

Lichtenstein, Bain, and Krauss therefore concur in believing the clay-slate and quartzite of the region between the Kromme and Kabeljouw rivers to be respectively identical and continuous with those of Cape Town, where the highly inclined beds of slate are surmounted by nearly horizontal sandstone. Mr. Bain, differing with the others, makes both cease here. I have little doubt of the continuity of the slate from Cape Town hither. I have none (as I shall presently show) of that of the Kromme and Kabeljouw region with those of the Zwartkops heights, and thence to the Fish River. Still, Mr. Bain is too able a man, and has generally too good reason for what he does, for any opinion of his to be passed over lightly. My own observations extend no further westward on this part of the coast than the region just mentioned; but as I think I can show that the relative positions of the quartzite mountain-ranges with the slate plains and valleys, clearly refer both to the like formations in the west, and as I have fossil and other evidence of their identity with the rocks further east, I will describe this region more fully.

The Kromme (winding) river runs for some miles from its source through a quartzite range, some few strata of slate here and there appearing in its bed; as, for instance, at the spot marked A in the sketch, where the slate contained vegetable stems. The main direction of the range, Cougha and Baviaans Kloofbergen, is about north 80° east. It sends off a branch, the Zitzi Komma (sometime called Kromme) heights, to Cape St. Francis, in direction north 44° west: another, some of the spurs of which skirt Hermansdorp and Hankey, the main direction being north 79° west. Thus these ranges diverge at an angle of about 35°; but, taking the spur, it would be nearer 60°. The Cougha bergen are, perhaps, 1500 to 1800 feet high; the Zitzi Komma 1000 to 1300. They are of quartzite sandstone of various degrees of hardness and crystalline character, often saccharine,



Plan of Country around St. Francis Bay.*

A. Spot in the Kromme river where fossils were found. B. Devonian fossils near this spot. C. Devonian fossils at Hermansdorp. D. Devonian fossils at Kabeljouw river mouth.

sometimes ivory-like. The line subtending this angle, drawn from near the mouth of the Kromme to the most eastern portion of the Gamtoos below Hankey, would pass over scarce anything but slate; with a slight curvature it would pass over no *quartzite*. As the strike of the slate is north 66° west, and the line nearly 15 miles long and making but a small angle with it, I believe the line would cross 12 miles of the strike. The dip of the rocks is considerable here; so

* The strike is too near perpendicular to the range of mountains, and the two ranges should have diverged at right angles.

that I think six or seven geographical miles for the depth of the section is a low estimate. A glance at the sketch would show that a few miles on in the strike a parallel line would pass through nothing but quartzite.

The quartzite mountains, therefore, and their spurs, cross the slate at considerable angles to the strike of the latter, and the mountain ranges enclose large angular areas of slate. I have stated just now that two parallel lines could be drawn, at the distance of some miles apart, which should cut a corresponding portion of the strike of the slate. Taking the smaller spurs of the ranges, and giving the lines no very considerable curve, two such lines might be drawn within two miles of each other. My reason for dwelling on this relation will appear presently. I would now beg of any geologist who has followed me thus far to pause and reflect on these relations of the slate and quartzite, and before proceeding to answer to himself, and if not too great a favour, to me, through the 'Geologist,' the following questions:—

1st, Supposing the relations just described to be correctly represented,* is it not clear that Mr. Bain and the other authorities quoted are right in classing the slates with the old rocks, and making the quartzite a newer and independent formation?

2nd, If the geologist should find rocks resting conformably on the same quartzite, would he not refer them (same postulate) to a much newer formation than the slate?

This is simply what Mr. Bain has done.

I will suppose it admitted that the clay-slate of the region between the Kromme and the Kabeljouw and Gamtoos rivers is probably of identical and continuous formation with that of Cape Town, and that of the quartzose rocks which cross it at various angles to its strike, are continuous and identical in character with those of Table Mountain. Then I think it will nót be disputed that these slates must have been upheaved into their present positions long ere the deposition of the quartzose sandstone or its assumption of its present condition, which Darwin attributes to the infiltration of silica.

Let us now see what grounds we have for forming a judgment as to the age of these slates, reminding the reader that Mr. Bain, from sections which I believe to be mainly correct, referred them to an epoch long preceding the Lower Silurian, which strata, resting on the quartzite, are supposed Upper Silurian (Devonian of European geologists), and rocks interstratified with like quartzite at the Maitland Mines and the eastern province generally are called Carboniferous.

Some time after the relations of the quartzite with the palæozoic and metamorphic rocks, observed in Namaqualand and in this province, had led me to predict that the former, throughout the colony, would be found to belong to one formation, Mr. Niven, of Jeffreys Bay, undertook, at my request, to search for fossil evidence bearing

* I have borrowed the pencil of a friend, Mr. R. Miller, to represent these relations more clearly to the eye. It is doubtful if the relation of the strike will be understood.

on this question. He soon discovered *Phacops Kafer*, *Orthis palmata*, *Spirifer antarcticus*. two species of Strophomena, and several of Encrinites, which clearly established the Devonian character of the slates about the mouth of the Kabeljouw river. Last year, in a professional journey to those parts, I was fortunate enough to find fossils in the bed of the Kromme river (*a*), near Diep river (*b*), and at Hermansdorp, which, together with the section, show that all these slates, supposed to be so ancient, were Devonian throughout. At different periods the discovery of the same species at Coxcomb, in Winterhoek, at Chatty, and Naroo, and a few weeks ago near Van Stadensberg, has clearly proved the identity of the palæozoic strata in the eastern province as far as the Fish River's mouth with the clay-slate of the region I have described, and almost certainly of Cape Town.

Now, the quartzite of the Cougha range is continuous with that of the Coxcomb, and both are so with the Van Stadensberg. I could give a sketch of very nearly the same relations of these ranges with the slate as those described, but they are not quite so well marked. The directions of the ranges of quartzite hills, as shown on any map of the colony, with the explanation that the strike differs not very considerably throughout the province, will render this unnecessary. The quartzite ought then to be newer than the Devonian in the Eastern province also. Yet in this province it has never been regarded by any geologist as otherwise than conformable with the Devonian (Carboniferous, Bain). Dr. Atherstone and I believe that of the Cougha as equally conformable with the Devonian slates of the Kromme, Kabeljouw, and Gamtoos. The relations of the mountain chains I have shown to be the same in both provinces.

I will now quote authorities to show that the conformability is unmistakeable in this province. If some of the extracts are long, it must be attributed to my belief that this is the most important part of my argument. If I can convince geologists that mountains 1200 to 3000 feet or more in height, which take the direction in reference to the strike, which, as I have said, any map of the colony will show they do take, are really composed of quartzose sandstone conformable, and at their junctions, and in valleys, interstratified with the Devonian slates they thus cross; it will, I think, be admitted that the rocks of this country (of different ages) have been subjected to a metamorphic action of a peculiar nature, and which has not received sufficient attention.*

Bain.—Carboniferous System. This system differs but little, lithologically, from the quartzose sandstones of the Silurian ranges of

* In explanation of the great desire I have always felt for the opinions of European geologists of note on the subject of these relations of our rock, I must remark, that I am quite a self-taught geologist, and have had no experience in any country but this. Moreover, all the colonial geologists, while admitting the relations described, see nothing inexplicable by admitted theories in them. Dr. Atherstone, for instance, believes that the quartzose sandstones were originally deposited in the positions mentioned, interstratified with the slates. Mr. Bain believed them of different and unconformable formation: so does Krauss. Since he has seen the Devonian fossils, Mr. Bain is inclined to think

the western parts of the colony (except that the carboniferous rocks have no pebbles). The quartzose sandstone, which is in general characteristic of this system, passes into chloritic schist at De Stade's and Van Staden's rivers, where mines of galena and copper have been for some time worked, but I fear not profitably.

"No workable coal has yet been discovered in this system; but numerous species of carboniferous plants have been found near the Kowie River, Woest's Hill, Slowison's Poort, and other localities in the talcose schist."—'Eastern Province Magazine,' vol. i. p. 456, Godlonton and White, Graham's Town. Compare with maps and description of strata, Geol. Trans.

Dr. Atherstone.—"Above the quartzose and micaceous sandstones and chloritic schists at the Maitland mines, and also along the Lorie River to Hankey, and still further on in the Gamtoos River, a dark grey fine-grained magnesian limestone is found. . . . Above this limestone in some places, as at the Maitland Mines, Van Staden's River, and the Loorie River, there is a hard and coarse sandstone with quartz pebbles, which makes excellent millstones. . . . Below the magnesian limestone lie conformably quartzose sandstones and micaceous shales and schists, similar to those of the carboniferous sandstones of the Zeurberg. The sandstones and schists of the Coxcomb and Winterberg range appear more like the Old Red Sandstone formation, and are infinitely more contorted than the carboniferous rocks; and as no fossils have as yet been found in them,* and the range appears

the slates and quartzites conformable, and that he has made a mistake in the boundary of the formation in the east, while he strongly affirms the accuracy of his section in the west.

It will be seen by reference to former Papers, that on my belief in the truth of Mr. Bain's section I founded the prediction that the clay-slate and Devonian would be proved one formation. When I use the word Devonian as applying to all our strata, I would explain that I make no pretension to settle the question of their age on my own authority, or to deny the possibility of there being strata as old or older than the Cambrian or older rocks in Britain. I simply mean that I have seen no reason for believing in any older rock unconformable with the Devonian; and I hope I have shown that the position of the quartzite, with reference to the latter, is the same as it is to the clay-slate, which Bain and Wylie believe so much older.

I ask for the aid I mention because I think the opinion of high authority would be of great value to us by showing what is regarded as credible, and what is not. The assistant-secretary of the Geological Society, some years ago, told me that the story of quartzite metamorphosis was rejected *in toto*. I hope the labours of Messrs. Sorby, Daubrée, Hunt, and others, have somewhat modified opinions. At the period in question my belief in this assimilation of rocks of different ages had not been confirmed by those discoveries which rendered the map published by the Society entirely obsolete as to some of the principal formations of the Colony. It was quite natural that under such circumstances the fulfilment of my early prediction should have been regarded as the confirmation of lucky guesses; but when I pointed out the fact that as to the Carboniferous and clay-slate formations, the result of my researches was, as I have said, to render the map obsolete, I think that in taking no notice of my communications the Society lost an opportunity.

* The discovery of Devonian fossils at the *northern* foot of the Coxcomb, in rocks with but a slight inclination, and that of the same species close to the Van Stadensberg, in beds with a dip of 46°, with a clear section connecting them with the schists at the De Stade's River mines, is singular in connection with this remark of my friend, and would seem to indicate that he has been misled as to the relative ages of formations in the east, in the same manner as Mr. Bain has further west.

continuous with the Zwarteberg range, which I believe to be Devonian, I should consider them also of the same age."—*Ibid.*, pp. 585–587.

Mr. Wylie, Government Geological Surveyor.—"Here" (at Goobeloan's northern base of the Zeurberg) "the shales disappear, and we enter upon rocks exactly the same as the Wittenbergen and the Koroo Poort sandstones in the western district. These continue all the way through the Zeurberg. Beside the yellowish or brownish sandstones there are many beds of very sandy shale, usually of a bright colour. Many of the sandstones cannot be distinguished from those of Table Mountain, though the latter are of much older date."*

"The sandstones of the Zeurberg form a great anticlinal arch; but this consists again of three great folds and two or more minor flexures. The beds may be seen dipping at all angles from 5° to 80°. On the seaward side of the Zeurberg, between the 20th and 21st milestones, I again crossed the trap conglomerate on the southern side of the anticlinal. It there forms a belt in width about 500 yards, and in actual thickness is not more than 500 or 600 feet. Grey shales occur both above and below it."—'Notes of a Journey,' etc., Cape Town, Saul, Solomon, & Co. (See also p. 3 of the same, and *passim.*)

There may be some little apparent confusion arising out of the different nomenclature used by the authorities I have quoted. The fact is, that the beds which are usually blue and clayey schists, with some argillaceous sandstones, are generally altered to a micaceous chloritic or talcose character, and in the upper part, when mixed with the sandstones, are ochry. The spots in which Devonian fossils have been found, together with the uniformity of strike, prove their identity throughout. This is now admitted by all observers as to this province.

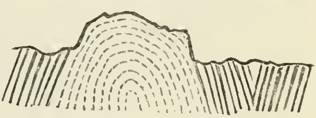


Fig. 1.—Section of Pickel Vontein. (Atherstone and Rubidge.)

The sections sent herewith are:—

1. Pickel Vontein, carefully observed by Dr. Atherstone and myself. 2. Chatty, measured by Mr. Pinchin and myself. 3. Section through Klein Poorden Poort, by Mr. Pinchin and myself. These have been merely sketched without measurement in the present instance, as I am unfortunately deprived of Mr. Pinchin's valuable aid. A carefully executed section was sent home to the Geological Society some years ago.

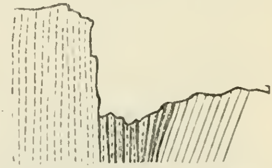


Fig. 2.—Section through Chatty. (Pinchin and Rubidge.)

I will conclude this paper by showing that what I have, I hope, satisfactorily proved of the quartzite, is also predicable of crystalline limestone or marble—viz. the continuity of horizontal beds unconformable with the subjacent strata, with beds of the same kind intercalated between the latter.

* Mr. Wylie, in his section of this part of the Colony, which, though not published, is placed in the Town Hall, in Cape Town, makes the shales above spoken of conformable with the sandstones.

I have described saccharine and finer-grained quartzites in this relation. I have now to mention that at Rodos, sixty miles from the mouth of the Orange River, strata of limestone rest in extensive masses on the mountains, I was told, horizontally; while below, only a comparatively few beds of saccharine and other varieties of crystalline limestone were interstratified with the gneiss.

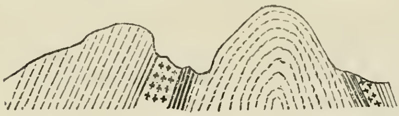


Fig. 3.—Section through Klein Poorden Poort. (Pinchin and Rubidge.)
aa, quartzite; *bbb*, slate; *c*, porphyry (Bain); *d*, porphyry.

I should hardly have thought it necessary to contest the igneous origin of marble at the present day, had I not seen in your Magazine the account of a recent experiment.

SOME ACCOUNT OF BARRETTIA, A NEW AND REMARKABLE FOSSIL SHELL FROM THE HIPPURITE LIMESTONE OF JAMAICA.

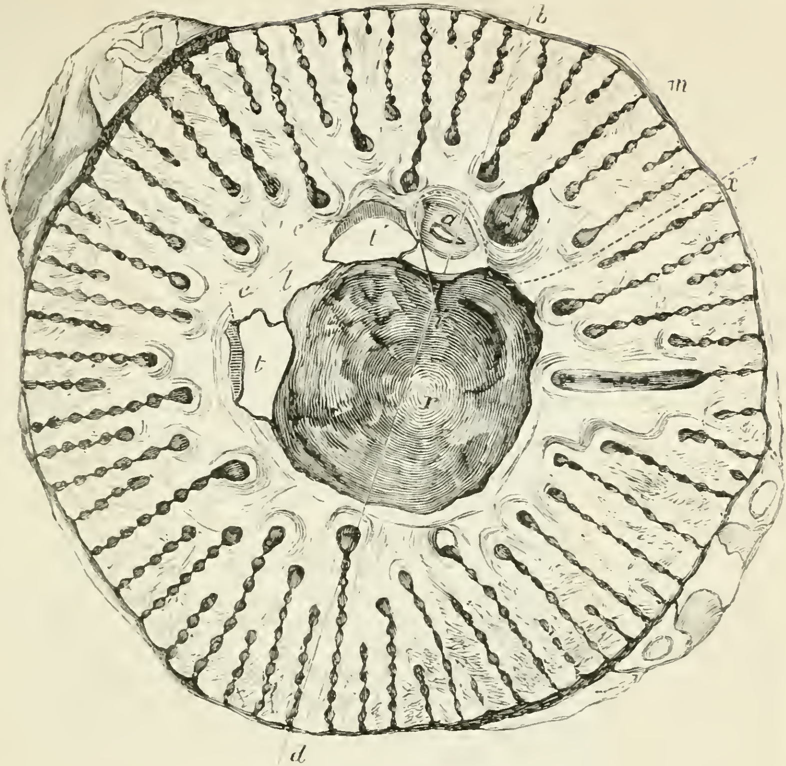
By S. P. Woodward, F.G.S.

The fossil represented in the accompanying figures is one of that kind whose discovery severely tests the faith of the naturalist in his previous conclusions, and may appear to raise a suspicion not only respecting the sufficiency of his data, but even as to the correctness of his method of investigation. Almost any person, at first sight of the specimen, would think he was looking at a *coral*, and it would seem like an attempt to impose on one's credulity to say it was a bivalve shell, like an oyster or a clam.*

Yet there is no doubt it is a kind of *Hippurite*, although the rays give it a novel and extraordinary character. The discoverer had quite satisfied himself on this point before he brought it to England and placed it in our hands. It was found last year (January, 1861), by Mr. Lucas Barrett, F.G.S., Director of the Geological Survey of the British West Indies, in the parish of Portland, in the north-east of

* This is not the only case of the sort. The genus *Goniophyllum*, one of the "Zoantharia rugosa," established by Milne-Edwards, is apparently identical with *Calceola*, the well-known bivalve fossil of the Eifel, placed by Lamarck with the "Rudistes," and admitted as a Brachiopod, with a sign of doubt, by Mr. Davidson and myself. *Goniophyllum pyramidale* is a scarce fossil of the Upper Silurian at Dudley and Malvern, but not uncommon in the Baltic island of Gothland. It was described as a *Calceola* by Girard in 1842. Another species, which is so like *Calceola sandalina* that Murchison and Verneuil assumed the existence of Devonian strata in Gothland, on the strength of its occurrence, has small rootlets of attachment along the borders of its "hinge-area," and a vesicular interior, like *Cystiphyllum*. After carefully examining a series of examples belonging to M. Lindström, of Wisby, we can only say that they are probably *neither* Brachiopoda nor Zoantharia, although very like each in some respects.

Fig. 5.

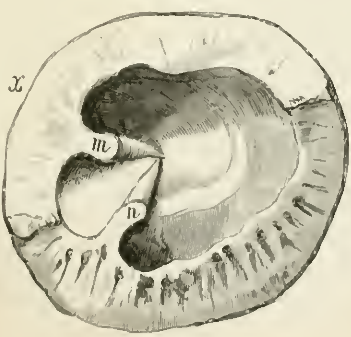


BARRETTIA MONILIFERA.

Hippurite Limestone, Jamaica.

(Reduced one-fifth.)

Fig. 6.



Upper Valve.

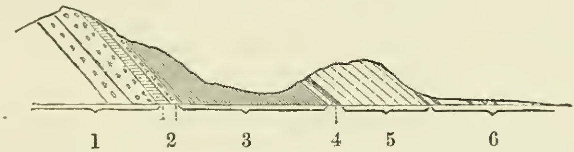
Fig. 7.

Lower Valve.

INTERIORS OF HIPPURITE, ANGOULEME.

Jamaica. This part of the island, lying to the north of the principal range of the Blue Mountains, which run east and west, is itself mountainous, rising to the height of 7000 feet. The hippurite limestone is well seen on the banks of the Back river, a tributary of the Rio Grande, at about fifteen miles from the coast. It is a hard, grey rock, occurring in bands of a few inches to a yard in thickness, subordinate to many hundreds of feet of shale which graduate upwards into other grey shales of the Eocene Tertiary, followed by white limestone of Miocene age.*

General Section of the Tertiary and Secondary Strata, East Jamaica.



1. Purple conglomerates. 2. Cretaceous limestone, with Hippurites. 3. Grey shales. 4. Orbitoidal limestone. 5. Miocene limestone. 6. Pliocene limestone and marls.

The appearance of the hippurite limestone of Jamaica is unlike that of any English cretaceous stratum. It abounds in small, oval bodies called *Orbitoides*, related to the Tertiary *Nummulites*, but mistaken by Sir Henry De la Beche for joints of the Encrinite (or *Entrochites*), and so leading him to compare this rock with the mountain limestone of England.† The other fossils of the limestone are *Radiolites*, *Inocerami*, a large *Nerinæa*, and an *Actæonella* resembling *A. lævis*, D'Orb. The two last-mentioned shells are also found in the island of St. Thomas. The hippurites are plentiful, but embedded in the solid rock, and only to be procured by blasting with gunpowder. They often form groups of two or three; the smaller individuals having grown upon the sides of the larger. The example figured is five inches in diameter, and was probably eighteen inches or two feet in length. The fossil was at first broken across several inches lower down than the line of section represented (fig. 5), and when ground and polished it exhibited only a solid mass of nearly white, calcareous spar, the centre being filled up with a vesicular structure, as in the Silurian coral *Cystiphyllum*. The dark-coloured, moniliform rays, and traces of the dental apparatus agreed exactly in size, number, and position with those in the section afterwards taken at a higher level, but only halfway across, which shows a central cavity filled with dark limestone. There are 65 radii, alternately longer and shorter; the longest are from 1 inch to $1\frac{1}{2}$, and have 7 to 10 beads; the short rays have 5 or 6 beads, sometimes fewer. A third section, $3\frac{1}{2}$ inches in diameter, and only 3 inches from the conical fixed end of the fossil, presents fewer rays (about 46), and less distinctly beaded. In each section two radii are more important than the rest, and correspond with the two longitudinal ridges (*m n*) that

* Quarterly Journal of the Geol. Soc. xvi. p. 324.

† Trans. Geol. Soc., 2nd series, vol. ii. pt. ii. p. 143.

are always visible in European specimens of the hippurite, which have become hollow by the dissolution of their inner layer of shell,* (fig. 7). These ridges are formed by the folding in of the outer wall of the shell, and it is evident that the numerous rays of the Jamaica fossil are produced by a repetition of the same process. They seem intended to compensate the tenuity of the outer wall, and perhaps are the cause of its reduction. In a specimen of *Hippurites cornu-vaccinum*, of equal size, the outer layer of shell is an inch thick, whereas in the Jamaica fossil it measures only three lines, and in a transverse section (fig. 4) exhibiting the lateral union of three (probably small) individuals, the *double* boundary-wall is less than a line in thickness. In the sections represented (figs. 2, 5), the outer shell-wall has chiefly been removed by accident or destroyed by mining parasites, except where preserved by investing corals and small *Radiolites*.

The upper end of the fossil was slightly convex, retaining the opercular valve in a somewhat damaged condition. When split longitudinally through the centre, it showed the body cavity, and two shelly processes descending from the lid (as in figure 2, *a a′*). Of these the right-hand, or posterior, *apophysis* (*a′*) projects into a cavity, which is so close to the principal inflection (*m*) that part of it is shown in the same figure. The beads of the rays in the transverse section are strung together by almost invisible lines; but in this longitudinal fracture they are seen to be continuous plates, and are striated on the side by lines of growth. At the summit they must have formed a series of radiating ridges, with furrows between, bordering the interior of the valve. The bottom of the body-cavity was also more irregular than usual in shells. The upper valve is perforated by a few large radiating canals, with canaliculi conducting to the outer surface (*x x*).

After it came into my possession, a fresh section was made across that half of the cylinder which contained the dental apparatus, in order to show the exact form and position of the hinge-teeth. They are seen in the figure (5, *a a′*) filling their sockets exactly, with the exception of small defined spaces on their outer sides, which form the only trace, at this level, of the cavities occupied by the divided cartilage (*c c′*). The interval between the dental sockets (*l*) is occupied by a solid, rectangular portion of shell, representing the single dental process of the lower valve. There is no "ligamental inflection" of the outer shell, as in *H. cornu-vaccinum*, and many other species.

The existence of the ligamental plate in the typical division of the genus *Hippurites* is accompanied by such an amount of displacement of the hinge as to justify the subgeneric separation of those species

* The inner layer of shells in the families *Pectinidæ* and *Chamidæ*, as well as the pearly lining of the *Aviculidæ*, *Turbinidæ*, etc., has the constitution of *Aragonite*, while the outer layer consists of *Calcite*, as stated by Gustav Rose, and confirmed by the observations of Mr. Sorby. The bi-axial character of mother-of-pearl may usually be detected with a tourmaline in any thin, translucent section, such as a counter or the edge of a pearl paper-knife.

in which the plate is wanting, and the cardinal apparatus lies close to the side of the shell instead of being at right angles to it.* We have already described and figured these peculiarities on former occasions, and it will be sufficient now to propose the name *Dorbignia* for *H. bi oculatus* and other hippurites (figs. 6, 7), which have no ligamental inflection, and a second subgeneric title, *Barrettia*, for the Jamaica fossil, which presents the further peculiarity of an indefinite number of pallial duplicatures extending all round the margin of the lower valve.

It still remains to speak of the shelly process from the upper valve (*a'*), seen in both our sections, descending into a pit between the posterior tooth (*t'*) and the principal duplicature (*m*). In the paper previously referred to we have described this process as the support of the posterior shell-muscle, having found characteristic indications of the muscular scar within the cavity which receives it. Since then, Professor Bayle, of the École des Mines at Paris, has published a description, with excellent figures, of some very complete examples of *Hippurites radiosus*. These specimens do not show any peculiarity unknown before, but they are far more perfect than the best we had ever seen, and exhibit in complete relief the extraordinary cardinal apparatus of the upper valve, of which our previous knowledge was chiefly obtained from sections. Owing to the condition of his specimens, M. Bayle has had the good fortune to procure, in a few weeks, better illustrations than we could obtain with much labour, continued at intervals for several years. Nevertheless, the very state of our materials has compelled a closer and longer examination, which we trust has not been thrown away! M. Bayle has quoted our views very fairly, and we hope he will yet see reason to adopt them. His memoir was accompanied by a critical notice from M. Deshayes containing the following passages:—

"Le travail de M. Woodward est le plus complet qui ait été publié sur l'ensemble des Rudistes. Cependant il reste bien des parties qui auraient demandé une discussion plus approfondie, des caractères qui, au point de vue zoologique, auraient pu être plus largement exposés et discutés."

"Avec le travail de M. Woodward, on pouvait encore concevoir des doutes sur quelques parties, et notamment sur le nombre et la position des muscles. Ce naturaliste suppose l'existence d'un muscle adducteur des valves de chaque côté de la charnière, exactement comme dans les Sphérulites; ce second muscle se serait attaché dans la profondeur de l'une des cavités cardinales de la valve inférieure et au sommet de l'une des apophyses de la valve supérieure; mais les pièces préparées par M. Bayle ne laissent plus de doute à ce sujet; les deux impressions musculaires sont portées d'un même côté, par suite d'un renversement de l'animal, comparable à ce qui existe chez les Hippopes et les Tridacnes, ainsi que M. Bayle lui-même l'a parfaitement compris; tout l'appareil musculaire, se trouvant

* 'Manual of the Mollusca,' pt. ii. p. 279 (1854), and Quarterly Journal of the Geol. Soc., vol. xi. p. 40, 1855. (Read May 24, 1854.)

transporté sur le côté antérieur de l'animal, n'est plus en antagonisme direct avec le ligament, et nous comprenons très-bien les motifs de l'hésitation de M. Woodward à ce sujet. L'absence d'un muscle du côté postérieur de la coquille laisse à deviner l'usage des deux arêtes saillantes dans l'intérieur du même côté, et celui des oscules de la valve supérieure qui leur correspondent. J'accueillerais volontiers l'idée de M. Bayle, qui suppose aux oscules la fonction de laisser pénétrer l'eau dans la cavité du manteau, et ils correspondraient aux siphons de l'animal ; c'est une vue théorique qui peut paraître plausible, mais qui n'a rien de prouvé."*

It must be regretted that M. Deshayes, whose notoriety as a conchologist was increased at the time by the circumstance of being President of the Geological Society of France, should have enunciated views which would be inexcusable in the veriest tyro in malacology. Their publication was the more surprising to me, because he had only just before examined my materials very fully and deliberately, and expressed his entire approval of my conclusions. If the author of the 'Mollusques Algériennes' would have taken the trouble to read my account of the *Tridacna*,† or, better still, if he had examined for himself one of the specimens brought home by Quoy and other celebrated voyagers, who have enriched the public museums of France, he would not have attributed to that bivalve a structure altogether incompatible with lamellibranchiate organization.

The readers of the 'Geologist' will pardon us for reminding them of such an elementary fact as that the bivalve shells like *Chama* are closed by two shell-muscles (*adductors*), one situated over or *behind* the mouth of the animal, the other *in front* of the posterior portion of the digestive canal. The whole body of the animal lies between them. The posterior adductor is developed first, and is invariably present. The anterior is usually smaller, and is wanting in the "monomyary" families, *Ostreidæ*, *Pectinidæ*, *Anomiadæ*, *Tridacnidæ*, and most of the *Aviculidæ*. In *Mulleria* it is always lost by the breaking away of the front of the valves, and sometimes it is worn away in *Clavagella*. In *Pholas* the expansion and reflection of the front margin gives the anterior adductor a position which converts it into a cardinal muscle. In *Tridacna* the single shell-muscle is placed just as in the oyster; that which M. Deshayes has mistaken for a second adductor, is the *pedal* muscle, which is conspicuous in all bivalves spinning a byssus, or having a powerful foot.

The posterior adductor of the Hippurite is situated exactly as in the Radiolite, but the supporting process projects vertically instead of expanding horizontally, and passes down into, but does not nearly fill, the deep pit between the hinge-teeth and the projecting ridge (*m*), which we have compared to the muscular plate of *Cucullæa* and other bivalves.‡ The position of this muscle is well represented by Goldfuss (at *c′*), in his small figure of the mould of *H. Lapeirousii*.

* Bull. Soc. Géol. France, séance du 21 mai 1855 (published March, 1856.)

† Ann. Nat. Hist., Feb. 1855, p. 100, and Supplement to 'Manual of Mollusca,' p. 469.

‡ Especially *Cardilia*, *Megalodon*, *Pachyrisma*, *Diceras*, and *Caprotina*.

(Petref. vol. ii. pl. 165, fig. 5, c). We have before pointed out that it is essential there should be space for the alimentary canal to pass between the hinge and posterior shell-muscle of a bivalve, and we have shown that such an opening is provided in the Hippurite and Radiolite by the undercutting of the muscular apophysis, which would otherwise close the whole interval (fig. 2, *i*). There is a hippurite in the British Museum which is hollow and empty, having been lined with only a thin film of spar. It is broken open at the side, and a wire has been passed round in the direction of the dotted line in fig. 5, *i x*, which is the course that must have been taken by the alimentary canal in the living animal. The nearest approximation to the hinge-structure of this genus is presented by the little *Caprotinæ*, found in soft yellow marls of Le Mans, in the Department of Sarthe, which may be cleared from the matrix without difficulty.

With respect to the other suggestion, that the two depressions in the lid of the Hippurite, (the *oculi* in *H. bioculatus*,) may be openings to facilitate the admission and escape of the branchial currents, it is only needful to observe that they have no existence *as orifices*, except in weathered specimens. These spots in the operculum correspond to the projecting columns in the lower valve, and fit down upon them closely. In the upper valve of *H. Loftusi*, figured in the 'Geological Journal' (pl. 3, fig. 4), portions of the columns remain adhering to the spots; and in the specimens now represented from Angoulême (figs. 6 and 7) the removal of the inner layer of shell has exposed the corresponding columns in each valve, while a portion broken from the lower valve is still attached to the upper, and shows the closeness of the contact at the place of the imaginary openings. The probable relation of the second column (*n*) to the respiratory currents of the animal was first suggested in our former descriptions.

EXPLANATION OF THE PLATES.

Plate XX.

Fig. 1.—*Barrettia monilifera;* group of three individuals, much reduced.

Fig. 2.—Longitudinal section of the upper part of a large specimen, reduced one-fifth.

Fig. 3.—Longitudinal section of a fragment, taken upon the line of union of three individuals.

Fig. 4.—Transverse section of the same specimen.

Plate XXI.

Fig. 5.—Transverse section of the same specimen as Fig. 2: *b d*, line of section; *r*, body-cavity of lower valve; *v*, umbonal cavity; *t*, dental process of lower valve; *t t′*, dental process of upper valve; *a a′*, adductor processes; *c c′*, cartilage pits; *m*, muscular inflection; *n*, siphonal inflection; *i*, probable course of alimentary canal and exhalent current; *x*, canals and canaliculi of upper valve.

Fig. 6.—Interior of upper valve of hippurite from Angoulême, with part of the wall of the lower valve adhering to it (marked *x*); the inner shell-layer wanting.

Fig. 7.—Interior of a lower valve from the same place.

THE GEOLOGY OF MAIDSTONE.

By W. H. Bensted, Esq.

(*Continued from page* 341.)

The lower mandible of a chimæra—the first discovered in the Lower Greensand—is now in the collection of Sir Philip Egerton, who informs me it belongs to the species *Ischyodus Agassizii*. Since this discovery I have met with many more specimens, some of smaller size; but, from the difficulty of extracting them from the stone, I have never succeeded in getting one so perfect. Several good specimens have been procured from the Lower Chalk at Burham. The chimæra approaches in form to the shark tribe, but it is far from being so ravenous in its disposition. Recent species are found in the Arctic and in some of the European seas, and attaining the length of two or three feet. Being often taken in the company of the herrings in their migrations, it has thus gained the patronymic of "king of the herrings." The mouth of this odd-looking fish is furnished with hard and undivided plates instead of teeth, four of which are placed on the upper and two on the lower jaw.

Fossils are very rare in the succeeding "rugged flint layers," which have an average thickness of eight inches.

The next stratum in the quarry to be noticed is the "grey hassock" bed. This stone is of very good texture for building, and contains a small species of Belemnite, which I have not seen in in any other layer. In this hassock there runs a thin bed of minute polished pebbles about the size of a pin's head, of various colours, and with them are mixed a profusion of small sharp-pointed fish-teeth. This accumulation appears to have been the result of a partial current, which carried away the small sand, leaving the larger pebbles as described. A species of Siphonia occurs in large quantities, marking the hassock with dark-grey wavy lines, but the stems are seldom distinct enough to be extracted from the stone.

There next follows a concretional layer, in which fossils rarely occur; then a soft hassock; and then a lower molluskite bed, similar to the upper one, with fossils.

"Soft hassock, No. 13," is a group of three layers of blue limestone, with two beds of hassock, having a total thickness of six feet. The group occupies a vertical space of about six feet. The shells found are peculiar to these beds, occurring only in them; and there is also an immense accumulation of detached spiculæ—the remains of dead sponges. It is in this group that the Scaphite makes its first general appearance, one specimen only having been met with higher in the series (in layer No. 2), but I have not been able to decide if that belongs to the same species.

This is followed by "soft limestone;" and to this, again, succeeds a second bed of "soft hassock" (No. 14) which presents us with a very large species of fucus or siphonia, in great profusion. It is traced in the hassock without difficulty from its clear blue colour, and by being composed of limestone. Within the stem a pith or cavity runs for a considerable distance, and portions have a ferruginous tinge. Very large specimens show the branched form of this organism. Another "soft limestone" next occurs, the same character as that recorded above.

The "soft hassock" (No. 15) has some interest attached to it by the discovery of a tooth of the Polyptychodon, of a much larger size than the one described at page 338. The enamel of this tooth is so friable that much of it shivered off in clearing away the sandstone which enveloped it, but enough remains to show the striæ which are one of its characteristic features. A rolled pebble or boulder of granite was found in this bed of "spiculæ hassock;" it weighs $8\frac{1}{2}$ lbs., and is of a flat oblong shape, about eight inches one way by five the other, and three inches thick. It has some Flustra attached to its surface, and the impression of a Trigonia is perceptible on one side. The latter seems to have been caused by the weight of the superincumbent strata pressing the shell close on the surface of the granite, although how the tracery of its form was impressed on so hard a substance is not easily to be understood. The Trigonia has not entered the boulder, but the outline is on the surface. For the granite, however, it is a seal identifying its locality. The occurrence of a fragment of primitive rock in a Secondary formation is interesting; and its solitary occurrence in a bed free from pebbles, and even coarse sand, gives rise to speculative conjecture as to the means of its envelopment. The sand is of very fine texture, and contains an immense quantity of detached spiculæ of dead sponges. The skeleton of a marine turtle was found not very far off, and a tooth of Polyptychodon occurred near the same spot. We have now causes in action giving rise to similar results. The sand from the coasts of New South Wales or some parts of Africa contains abundance of spiculæ of all descriptions; the same is the case with the sand from the West India Islands, arising from the decomposition of myriads of spongeous bodies with which the bottom of the seas in those regions is covered. There can be no doubt but that the sand of the sandstone of the Lower Greensand here has been accumulated under similar circumstances. Skeletons of the turtles, and teeth and bones of the fishes inhabiting that ancient sea, are found mingled with the sand and detached spiculæ, but the boulder was probably rolled into its spherical figure in association and in contact with fragments of rock of equal size and hardness with itself. The presence of the cells of the delicate Flustra shows clearly that it had not been rolled in the sand in which it was enveloped, and the attachment of a small shell to its surface indicates a tranquil state of the waters around it. It is difficult to account for its presence. Icebergs are known to transport fragments of rock to a considerable distance, but an objection to the iceberg-carriage is found in the present case in the high temperature of the Lower Greensand sea, which was inhabited by tropical species of shells and zoophytes.

The "Black Greys" (border) is one of the most remarkable of the whole series of beds displayed in the Iguanodon quarry. Its sandy border contains an immense accumulation of organic remains —all marine, with the exception of fragments of wood perforated by teredines, of which animals, in most cases, the sheaths remain. The sandstone is of a dark grey, hard and coarse in texture, and about twelve inches thick. A portion is full of the casts and markings of Siphoniæ and *Fucus Targonii*. Casts of *Trigonia alæformis* are very abundant, and, as in the Molluskite layer, the shells are open, and of the dead mollusks the carbonaceous matter is found in large quantities. At the junction of the hassock with the limestone beneath it, two beds containing shells in great profusion. The first contains chiefly the shells of a *Panopea*, but the substance of the shell is now nothing more than a slight film of lime, which falls to dust when dry. The difficulty of getting specimens is also greatly increased by their crushed condition, being almost flattened by the pressure they have undergone. Immediately under this vein of shells, and sometimes mingling with them, is seen for the first time a bed of the characteristic Gryphæa, or Exogyra. These shells often occur in groups of considerable numbers, and I have had five good specimens within a thickness of stone not exceeding three inches. This bed of shells appears to have only existed for a short period, as the occurrence of an individual in any part of the remaining portion of the layer is rarely seen; and, indeed, the stone is remarkably free from any remains of animal life. The accumulation of Siphoniæ gives the rough fracture so generally found in ragstone, but occasionally a smooth flat surface is obtained by cleavage. The hassock contains many nodules of clear blue limestone, very similar to septaria. This occurrence in the coarse sandstone is remarkable, as the stone is of a very clear structure, light blue in colour, and in some instances of a pear-shaped figure, from which I attribute their origin to zoophytic structure, although no traces of such structure has been detected.

Below the last-mentioned layer the stone is of inferior quality. The fossils are of the same kind as those occurring in the border of the "Black Greys." The only opportunity I have had of examining them was during the sinking of a well, when water was found at twelve feet below the "Black Greys." Detached spiculæ, Trigoniæ, Plagiostomæ, stems of Siphoniæ, Plicatulæ, and Belemnites, were very abundant. The layers were as under:—

Concretionary masses of greyish limestone, from 6 to 12 inches in thickness. Few fossils.
Hard coarse hassock, 2 feet in thickness. Siphoniæ in large masses; casts of *Trigoniæ alæformis*.
Thin layer of stone.
Soft hassock, about 6 inches, with spiculæ.
Grey-blue limestone of clear fracture. Few shells. 6 to 7 inches thick.
Hard hassock, 18 inches. Impressions of Siphoniæ.

Water was then found in loose rubbly layers of stone.

Having now terminated the description of the series found in my quarry, we pass on to the other members of the Lower Greensand found in the Maidstone district. Below the Kentish rag beds comes the Atherfield clay. This formation is passed through in the railway-cutting at Tetsom, where it is seen basseting out from beneath the hills of ragstone. A list of the fossils of this division of the Lower Cretaceous rocks has been published by Dr. Fitton in the Transactions of the Geological Society, vol. iv. part 2, 1836.

The junction with the Weald clay may be clearly traced at this place, and laminated beds of fawn-coloured stone are met, containing seams of small Paludinæ, Cyprides, teeth and bones of fish, and also the elytra, or wing-cases, of beetles. In 1851, the Weald clay was met with in digging a drain in St. Faith's Street (Maidstone). At a depth of from eight to ten feet, a series of slate-coloured slabs of stone was found, in which Wealden fossils (Cypris) were to be seen lying in close proximity. The edges of these slabs were rounded, and a ferruginous border of a quarter of an inch enveloped the stone. I conjecture that it is this border which is found in a broken and waterworn state, mixed with the drift, at various places round Maidstone.

Section of a Boring at Mr. Fish's Brewery.

12 feet.	Débris of Medway, gravel flints, rolled rag-stone.
88 feet.	Atherfield clay (stiff blue clay).
30 feet.	Mixed sands (fine-grained greyish-white).
10 feet.	Red, blue, and yellow clay.
30 feet.	Grit and clay (greenish-grey) with Paludina.
	Stratum of Bethersden marble.
45 feet.	Very hard close-grained brown sands.
5 feet.	Variegated clays (red and white).
40 feet.	Brown sand.
90 feet.	Blue clay, with crushed shells.
Y	360 feet.

In 1847, Mr. Fish commenced a boring for the supply of water for his brewery. Wishing to obtain a supply free from the acidity of decayed vegetable matter, he set out with the intention of going sufficiently deep to secure that result. After passing through about twelve feet of the débris of the ancient Medway, he came to a dark-blue clay of soapy texture, with veins of greyish white. No fossils were obtained. In this clay a supply of water was obtained, but it was not equal to the demand,—the water, turbid from the clay which it held in suspension, requiring a long time for its precipitation. After next passing through about 88 feet of clay, a bed of fine-grained sand was met, 30 feet in thickness; the sand, when dry, was of a greyish white. Then followed a bed of clay, red, blue, and yellow, 10 feet. At 170 feet, a most interesting bed of grit and clay, of a light green, was found, with many fragments of Paludinæ identical with those of the Wealden clays elsewhere. At 10 feet below this, a stratum of hard limestone gave great obstruction to the boring. This bed, from an inspection of two small fragments, I believe to be a layer of the Bethersden marble, containing Paludinæ of much smaller size than those of the clay above. About 45 feet of very compact brown sands now gave great opposition to the auger, as the friction wore its edge rapidly away. Mottled clay, red and white, sometimes streaked with much regularity, was next pierced for 5 feet, and a second brown sand passed through for 40 feet. A bed of blue clay, with crushed shells, to the extent of 90 feet, was now bored into, and a supply of water was considered to have been met with; but the quantity was not large, and the water was turbid. The total depth sunk was 360 feet.

Several other borings have been begun at various places, but have not been gone on with to a depth sufficient to pass through the Weald clay. The marine blue clay (Atherfield) I have noticed as far from the cropping out at Teston as the north-west side of the town; and opposite the depôt, and close to the river, a depth of 50 feet of blue clay was entered by a railway surveyor.

At Turkey Mill (Whatman's) a blue clay was found near the surface, in the valley, with a layer of Paludinæ a foot in thickness, very compact, the shells belonging to a very small species. This locality is at least five miles from the escarpment of greensand at Linton.

(*To be continued.*)

GEOLOGICAL NOTES IN THE GREAT EXHIBITION.

Canada.—The collection of specimens of rocks and minerals from Canada, exhibited by the Government Geological Survey, is, as a practical and complete industrial collection, unequalled by any other mineral collection in the whole Exhibition; and the catalogue of 90 closely printed pages which accompanies them is a masterpiece of its kind, and well worthy of its eminent and indefatigable author, Sir William Logan. Besides the collection of specimens, the published geographical and geological maps, the palæontological books and plates, and the printed reports of the survey are also exhibited. From the index to the geological maps we get, of course, the recognized geological groups of rocks and the order of their succession. So far as this index at present goes, it does not carry us higher than the Carboniferous series. Of the mineral specimens, amongst the metals and their ores the most remarkable are those of the bog-iron ore from Radnor Forges, Batescan; deposits of bog-iron ore of alluvial age are spread out, in greater or less abundance, from the north side of the St. Lawrence, and between it and the Lawrentide Hills, all the way from St. Anne des Plaines to

Portneuf—a distance of more than a hundred miles. In this area the ore seems to be concentrated in the neighbourhood of the St. Maurice and Batescan rivers; and iron has been smelted in the neighbourhood of these three rivers for upwards of a century. The ore with which the Radnor furnaces are supplied is derived from the seignories of Cap de la Madelaine and Champlain, where it occurs close to the surface in a multitude of patches of from 3 to 24 inches in thickness. It is brought to the furnaces partly by the workmen of the Forge Company and partly by the various farmers on whose lands the ore occurs. The ore is washed at the smelting-works to free it from soil, and it then contains from 40 to 50 per cent. of iron. Other specimens of bog ore are exhibited, from Vaudreuil, where the bed is from 4 to 8 feet thick, and there lies beneath it in some parts a thin stratum of blue phosphate of iron. At St. Vallier in Bellechasse there is an interrupted bed of from 12 to 20 miles thick and over 10 or 15 square miles, near the junction of the two branches of the Rivière du Sud.

Of red hematite, or oligist ore, there is a fine sample from an unworked bed of 30 feet thick, resting upon crystalline Laurentian limestone, and limited at top by the magnesian limestone of the calciferous group. Analysis gives 58 per cent. of iron.

Of magnetic ore there are highly interesting samples. From Sutton we have it from a bed 12 feet thick, consisting of dolomite abounding in small crystals of the magnetic oxide of iron. From the "big iron-ore bed of Marmora," which is not however a single bed, but a succession—over 100 feet thick—interstratified between gneiss or crystalline limestone. From Hadborough and Crosley, from a bed 200 feet thick in gneiss; samples of numerous other beds in Laurentian gneiss are also displayed; and there is a specimen of ilmenite with rutile from St. Urbain, Bay of St. Paul. The latter bed is 90 feet thick, and interstratified in anorthorite rock, also of Laurentian age. Samples of lead ores are shown from the Lower Helderberg group, Quebec group, Calciferous formation, and the Laurentian rocks—in the latter case cutting crystalline limestone;—of copper from Laurentian gneiss, and from the well-known Bruce Mines, where a group of lodes intersect a thick mass of greenstone trap in the Huronian formation; from Acton, in dolomite, at the base of the Quebec group; and from many other mines in that formation: native from a lode in St. Ignace Island, Lake Superior, where the vein cuts a thick mass of amygdaloidal diorite conformable with the strata,—the vein is about 5 inches thick, and many of the masses of native copper weigh upwards of 100 lbs., accompanied by native silver, in a gangue of calcspar. Copper-ore is shown from other places, all in the Quebec group; amongst them Mamainse, on Lake Superior, from whence is 450 lbs. in a single sheet from a vein. The promontory of Mamainse consists of various layers of coarse conglomerate and of amygdaloidal greenstone, in one of the bands of the latter bay intersected by a narrow fissure running N. and S., nearly in the strike of the beds; its greatest width is 6 inches, and in some places it is found to be nearly filled with native copper; other veins intersect the same rock. In ancient shallow holes sunk at intervals along the course of some of these veins of metallic copper there are occasionally found the remains of Indian hammers, consisting of small boulders usually of trap, having shallow grooves worked round them to receive the withes or thongs attaching the handles—evidence of the rude aboriginal attempts at mining many centuries since. From the Quebec group we have also sulphuret of nickel (Millerite) and native silver.

It has long been ascertained that the drift of the south side of the St. Lawrence, from Lake Champion to the Etchemin and probably to the extremity of Gaspé, is auriferous; the area being about 15,000 square miles. Gold has been washed from this gravel on the St. Francis in Melbourne, at Sherbrooke in Westbury, Weedon, and Dudswell, and on Lake St. Francis, Rivière des Plantes (Vaudreuil), and along the Rivière du Loup, near its junction with the Chaudière. From the numerous small masses of gold obtained from the Chaudière valley, there cannot be much doubt that the drift-gold of the region has been derived from quartz veins situated probably not very far distant. Gold grains have been seen in a quartz vein, between 2 and 3 feet thick, cutting the bluish-black slate of the Quebec group about a mile below the St. Francis Rapids.

Among the gold-drift of the Chaudière there are met in small quantities grains of platinum and of iridosmine,—an alloy of the rare metals iridium and osmium, which, being very hard, is used for pointing gold pens. Some of the gold met with also has been found thinly coated with a mercurial amalgam; but no trace of cinnabar, the common form of ore of mercury, has been observed in the drift. Amongst the substances met with by the Canada Gold Mining Company, in separating the gold from the drift, are lead shot of various sizes, from partridge to swan shot, and which are nearly as abundant as the gold.

Of the minerals applicable to chemical manufactures we have chromic iron, from the Quebec group; molybdenite, from Laurentian gneiss; cobaltiferous pyrites, from Laurentian gneiss. In the Eastern Townships a vast quantity of dolomite occurs. Stratigraphically it is at the base of the Quebec group, where magnesian rocks are associated with the sulphurets of copper and other metals. One of the rocks associated with or replacing the dolomite is magnesite. Specimens are shown from Sutton and Bolton. The finest kind contains 80 per cent. of magnesia, with a portion of carbonate of iron. In Bolton it forms an enormous bed, resembling crystalline limestone. Though the use of this mineral as an economic source of magnesia is on a large scale, its most important application is for the manufacture of a cement to resist the action of sea-water.

Petroleum, or rock-oil, in all its states, such as green or mineral tar from the surface, crude oil from the well, refined or burning oil, and lubricating oil for machinery, is exhibited by the Canadian Oil Company. The bituminous shale of the Utica formation yields, when distilled, from 3 to 4 per cent. of tarry oil, which by the usual process of rectification yields oil for illumination and lubrication.

Magnificent specimens of phosphate of lime (apatite) are sent from North Elmsley and South Burgess. At the former place the deposit has been traced for a distance of a mile, apparently forming an irregular bed on the Laurentian limestone. On lot 25, where it has been quarried, the breadth of the bed is about ten feet, of which three feet are nearly pure crystalline apatite, with only a small admixture of black mica; the remainder is mingled with limestone, the phosphate predominating. This deposit seems to be continued south-westerly through Burgess.

We now pass to the Refractory Minerals. Among the magnesian rocks at the base of the Quebec group, in that part of its distribution where it is in a metamorphic state, soapstone, or steatite occurs in great abundance. Beds of it, varying from 1 to 16 feet thick, can be traced for long distances, usually not far removed from serpentine-dolomite or magnesite, or apparently replacing one of these rocks. In general the soapstone is remarkably pure, but occasionally there are disseminated in it crystals of bitter spar or of actinolite. The specimens exhibited are from Sutton and Bolton.

A considerable portion of the rocks of the Quebec group in their metamorphic condition consists of chloritic slates, which appear to occupy a higher stratigraphical position than the magnesian strata just noticed. Magnesian mica, or phlogopite, occurs abundantly in small scales in the crystalline limestone of the Laurentian system, but sometimes also in crystals sufficiently large to be economically available. Among its associated minerals are commonly quartz, pyroxene, and feldspar, and occasionally tabular spar, apatite, spheric iron pyrites, idocrase, garnet, tourmaline, zircon, and corundum. In Grenville crystals of mica have been obtained, giving sheets measuring 24 by 14 inches. In North Burgess, where it has been mined, the mica is embedded in a soft pyroxenic rock and limited by a band of quartzite on the south side. The mica there appears to run for 75 yards in tolerably regular bands, and some of the sheets after being dressed are as much as 20 inches square; some have been obtained measuring 20 by 30 inches. The crystalline limestones of the Laurentian system are marked almost universally by the occurrence of graphite or plumbago in small scales, which are often so thickly disseminated in particular bands of the rock as to give them a black or dark grey colour, distinctly marking the stratification. Plumbago also occurs in beds, of sufficient purity and quality to be economically available. The workable beds are chiefly on the north side of the Ottawa, and occur in many localities at considerable distances from one another, but several of the exposures are probably repetitions of the same bed, or at any rate of beds approximately equivalent in repetition of the same band of Laurentian limestone. The whole Laurentian series is so corrugated that the outcrop of one of these bands of limestone in the counties of Argenteuil and Two Mountains, followed through all its windings in an area of fifty miles by twenty, measures upwards of two hundred miles. A bed of pure graphite occurs in the augmentation of Grenville township, and has been traced at intervals for a distance of three miles. One of these exposures has been mined by Messrs. Russell & Co., and at the opening of the excavation the graphite showed a thickness of ten inches; but the pure substance was found to form a lenticular mass, separated from other masses of the same character by intervals in which the graphite became mixed with the limestone. It is probable that a number of these lenticular masses running through the rock at the same horizon may represent the general character of the workable beds. Asbestos, generally a fibrous serpentine or chrysolite, occurs in veins cutting the serpentine of the Quebec group in the Eastern Townships (St. Joseph Seigniory). A friable sandstone in the Potsdam formation occurs at Pittsburgh, twenty feet thick, and is much in demand for protecting the sides and bottoms of iron foundries. It is supplied to those at Montreal and Toronto, at distances of a hundred and seventy miles in opposite directions.

Of the minerals applicable to common or decorative construction it would be perhaps of no great service to English geologists to give very minute details. Still however the characters of the samples, as indicative of the nature of the rocks constituting the formations to which they belong, will be at least interesting. We begin with a sample from one of the bands of crystalline limestone of the Laurentian series from the Lac des Chats. Another building-stone comes from Phillipsburg (St. Armand); the rock is compact and crystalline, and of considerable strength. A few obscure fossils show the formation to be the Calciferous of the Quebec group. There are specimens of building-stones from Caughnawaga, St. Dominique, and East Hawkesbury, all from the Chazy formation, which in those districts is composed of massive beds yielding blocks of stone fitted for canal locks and railway bridges. The beds abound with the remains of encrinites and cystidians, and these give to the rock a crystalline texture which constitutes one of its valuable characters. The stones from Pointe Claire and Cornwall belong to the Bird's Eye and Black River formation. They are black, compact, and thick-bedded. The Trenton formation, which is next above the "Bird's Eye and Black River," yields excellent building-stone at Montreal, at Chevrotière, and many other places. The best stone in Montreal is from a ten-feet band of grey bituminous limestone near the base of the formation, and which is a mass of comminuted organic remains consisting largely of the ruins of crinoids and cystidians. The best houses in Montreal are built of this stone. The strata in the neighbourhood of that city are much traversed by trap dykes, which have probably a connection with an intrusive mass extending over seven hundred acres, and constituting Mount Royal, from which the city and the island take their names.

The Niagara formation, the equivalent of our Middle Silurian, produces a beautiful and enduring dolomite at Owen Sound. A rather more compact dolomitic stone comes from the lower part of the Niagara formation at Noisy Clear Falls, Nottawasaga. Another excellent specimen is shown from Rookwood, Eramosa. The Guelph formation extends over a large area, and much of the rock is of the same character as the specimen in the collection from the thriving town of Guelph, where the quarries expose about 15 feet of light grey crystalline dolomite; easily worked, it is suitable for the best architectural purposes, and appears to be very durable. But Oxbow, on the Saugeen River, furnishes the best dolomite for fine architectural purposes which has yet been discovered in Canada. It resembles Caen stone in the facility with which it can be worked; but it is closer-grained and by no means so absorbent. There are two bands of stone there, each about 10 feet thick, in the upper part of the Onondaga formation; the above is from the upper band: the lower band has a very light grey oolitic bed, 17 inches thick, that is much used for supporting water-wheels in mills in the neighbourhood, and is found to answer well, becoming highly polished under the action of a revolving shaft. Lyn, Elizabethtown, Nepean, Grenville, Quin's Point, furnish specimens of the Potsdam sandstone, which constitutes the summit of the lowest group of fossiliferous rocks in Canada. At Lyn the massive beds of that formation are seen resting on Laurentian gneiss. Amongst other samples are, from Pembroke, a fine freestone from the Chazy beds; from Hamilton, Burton, a fine-grained sandstone, 10 feet in thickness, the "grey band" of the Medina formation (Middle Silurian); from Georgetown, Esquesing, and Nottawasaga, a light-grey freestone, 20 feet thick (Medina "grey band"); and from North Cayuga a white sandstone belonging to the Oriskany formation (Devonian), which runs through Haldemand county in Lower Canada. From Abercrombie, labradorite from the Laurentian formation; it is of the opalescent variety, which occurs in cleavable masses in a fine-grained base of the same mineral, composing mountain masses. When these are thickly disseminated in the paste, the stone becomes a beautiful decorative material, applicable to architectural embellishment and articles of furniture. Its hardness is about that of ordinary feldspar, and it would in consequence be more expensive to cut and polish than serpentine or marble, but it is not so readily scratched or broken, and would therefore prove more lasting. Professor Emmons states that a block submitted to the action of a common saw used in sawing marble, moved by the waste power of a common water-mill, was cut to the depth of 2 inches in a day, which is understood to be one-fifth the amount that would be cut in a block of good marble in the same time. It would thus appear, that though the operation is slower in the case of the labradorite there is no greater amount of mechanical contrivance required than for marble, and that slabs could be prepared for chimney-pieces and other articles of furniture at a cost beyond that of marble not greater than is proportionate to the superior beauty and durability of the material. The foot square of gneiss ought to be looked upon with reverence, as a sample of the oldest stratified (?) rock on our globe; a piece of the floor in reality of the great superstructure of the earth's crust. Mr. O. Donnell, C.E., of Quebec, sends a specimen of the gneiss used for building the reservoir of the Quebec Waterworks on the St. Charles river. It is hornblendic and composed of translucent colourless quartz, white orthoclase (the feldspar predominating over the quartz), and black hornblende, all running in irregular parallel planes, showing the gneissoid structure very distinctly, and having at a little distance a general grey colour. The rock splits in almost any direction by means of wedges, but most easily on that of the gneissoid layers, particularly where these are even. The layers are however occasionally affected by undulations and contortions, but these do not materially affect its division by wedges. The rock splits and dresses with most difficulty at right angles to the gneissoid layers. It is capable of receiving fine smooth faces, giving sharp edges and corners. Masses of almost any size can be blasted out from the rock. From Grenville we have a specimen of porphyroid orthoclase gneiss, which forms great mountain-ranges among the Laurentian rocks, rising into the highest peaks of the orthoclase region, and generally constituting the main body of the rock separating one important band of limestone from another. These masses appear to attain several thousand feet in thickness, divided however at unequal intervals by thinner and less feldspathic bands, in which the stratification is more distinct.

The intrusive masses of the Laurentian series consist chiefly of syenite and dolerite. These occur in many parts of the country, but their relative ages have been ascertained almost altogether by the investigation of the counties of Ottawa and Argenteuil. What appear to be the oldest are a set of dykes of a rather fine-grained dark greenish-grey greenstone or dolerite, varying in thickness from a few feet to 100 yards. Their general bearing appears to be E. to W. These greenstone dykes are interrupted by an intrusive syenite, a mass of which occupies an area of 36 square miles in the townships of Grenville, Chatham, and Wentworth; specimens of this syenite are exhibited, as also from a mass of a similar character occurring between Kingston and Gananoque. In Grenville the syenite is penetrated by dykes of a porphyritic character. These masses belong to what has been called felsite porphyry, hornstone porphyry, or orthophyre, having for its base an intimate mixture of orthoclase and quartz, coloured by oxide of iron, and varying in colour from green to various shades of black. Throughout the part which is homogeneous and conchoidal in its fracture, are disseminated well-defined crystals of a rose-red or flesh-red feldspar, apparently orthoclase, and less frequently small grains of a nearly colourless quartz. All these intrusive masses are cut by another set of dolerite dykes, which probably belong to the Silurian period or perhaps to the Devonian.

Two specimens of granite are exhibited, one from St. Joseph Beauce, where the band of granite—about 50 or 60 feet thick—has been worked for millstones. It has a considerable proportion of quartz, and would be a strong and durable stone for building. It runs with the stratification near to a band of serpentine, and is supposed to be an altered and not an intrusive rock. It occurs in the Quebec group of the Lower Silurian. An intrusive granite of Devonian age occurs in considerable abundance in the eastern townships and forms many isolated hills, the whole of them of small size with the exception of the Great Megantic Mountain, which occupies an area of about 12 square miles. It is composed of white quartz and white orthoclase feldspar, with black mica. An area of this rock occurs in Stanstead, covering 6 square miles, and forming Biby Plains. Another occurs in Barnston, from which the second sample exhibited has been taken. Granite of the same character, and probably of the same age, is widely distributed in the State of Maine, and is traceable to New Brunswick, where it is overlaid by the carboniferous rocks.

Marbles are exhibited from the Laurentian, Quebec, Chazy, Bird's Eye and Black River, Trenton and Upper Helderberg formations; and serpentine from Oxford, Melbourne, and St. Joseph Beauce. The band of serpentine from different places on which the samples have been obtained has been traced on the south side of the St. Lawrence, from Potton to Cranbourne, 140 miles; in 40 miles of which it is twice repeated by undulations, giving an additional 80 miles to its outcrop. It is again recognized 250 miles further to the N.E. in Mount Albert, on the Shickshock Mountains, and about 70 miles further in Mount Serpentine, approaching Gaspé Bay. All the specimens of the rock which have been analysed contain small quantities of chromium and nickel, and the band is associated in its distribution with soapstone, potstone, dolomite, and magnesite. The whole of these occur in large quantities, and in them as well as in the serpentine chromic iron occurs, sometimes in workable quantities.

These rocks or others immediately near them contain the metals iron, lead, copper, nickel, silver, gold, and with the drift-gold derived from these beds are platinum, iridosmine, and traces of mercury. In 1847 these serpentines, from their distribution, were described in the Reports of the Survey as altered sedimentary rock; and all subsequent observations have confirmed this view. Regularly stratified masses have been found in Mount Albert belonging to the Quebec group.

Roofing slates are exhibited from a band of slate in immediate contact with the summit of the serpentine. It has a breadth of $\frac{1}{3}$ of a mile, and dips about 80° S.E. Mr. Walton commenced opening a quarry upon it in 1860, and found it necessary, to gain access to the slate, to make a tunnel through the serpentine, to effect which, and expose a sufficient face for working, has taken two years, and cost 30,000 dollars.

Up to a comparatively recent period. the usual coverings of houses in Canada have been wood, shingles, and galvanized iron or tin plate; but so many fires have happened by the use of the former that they are now interdicted in all large towns. Those exhibited are from Mr. Walton's quarry, which has now been in operation since 1861, and these slates are now being sent to distances of more than 500 miles. The strong resemblance between these Melbourne slates and those from Bangor, in Wales, and Angers, in France, may be seen by the following analyses by Mr. F. Sterry Hunt:—

	Welsh.	French.	Canadian.
Silica	60·50	57·00	64·20
Alumina	19·70	20·10	16·80
Protoxide of Iron	7·83	10·98	4·23
Lime	1·12	1·23	0·73
Magnesia	2·20	3·39	3·94
Potash	3·18	1·70	3 26
Soda	2·20	1·30	3·07
Water	3·30	4.40	3·40
	100·03	100·13	99·63

The proximity of the serpentine leaves no doubt as to their geological horizon being that of the Quebec group of the Lower Silurian. Four other samples of slates have been sent to the Exhibition; of these, the Cleveland and the Shipton slates are a continuation of the Melbourne band; the slates from Orford may be of the same band; but the geological horizon of those from Tring is uncertain, although they probably belong to the Quebec group. The Kingsey slates appear to be lower in the series than the magnesian group of strata. Flagstones are exhibited from the Medina "grey band," and hydraulic lime from the Clinton formation at St. Catherine's. The bed which yields this—"the Thorold cement"—is a dark brown dolomite, and 80,000 bushels have been annually made. There is another sample of hydraulic lime from Walkerton, made from beds of 2 to 11 miles, occasionally separated by layers of shale, in the total amounting to 15 feet, and belonging to the Onondaga formation. The practical manufacture of this latter cement has not however been yet attempted for commercial purposes. Other samples are also samples from Limehouse (Clinton group), Nepean (Chazy formation), Rockwood (Niagara group), and Magdalen River (Hudson River formation). Common lime is shown from stone belonging to the Guelph and Onondaga formations, and from the building-stone of Montreal, where 270,000 tons are annually made.

The common bricks exhibited are all made from drift or alluvial clays. Whetstones are shown from the Quebec group, Hudson River, and Medina formations. The mica-slates also which are associated with the crystalline limestone of the Laurentian series are frequently of the character required for scythe-stones. The whetstone rock occurs in immediate contact with a thick band of conglomerate, the pebbles of which are frequently large, some of them 6 inches in diameter; they are chiefly of quartz, but some are of feldspar and some calcareous. The quartz pebbles are for the most part distinctly rounded. Some of the siliceous slates of the Huronian series yield very fine hones; they are usually of a green colour, and occupy a place in the lower part of the series. Grindstones are shown from the Medina "grey band," and millstones from the Oriskany formation. Millstones or dressed buhrstone (Laurentian) is also exhibited from Grenville. This buhrstone constitutes a series of veins cutting an intrusive mass of syenite, which occupies an area of 36 square miles, amongst the Laurentian rocks of Grenville, Chatham, and Wentworth. The veins consist of yellowish-brown or flesh-red cellular chert, and the stone has the chemical composition of flint or chalcedony. The attitude and associations of the chert show clearly that it cannot be of sedimentary origin, and its composition taken in conjunction with the igneous character of the district suggests the idea that it is an aqueous deposit which has filled up fissures in the syenite, and is similar in its origin to the agate or chalcedony which in smaller masses are common in various rocks. For a distance of perhaps 200 yards on each side of these veins of chert, while the quartz of the syenite remains unchanged, the feldspar has been more or less decomposed, and is converted into a sort of kaolin. As this process involves a separation of the silica from the feldspar, it is not improbable that it has been the origin of the veins of silex.

Mineral manures are now an important division of economic geology. Gypsum is shown from the Onondaga formation on the Grand River; alluvial freshwater shell-marl from deposits at New Edinburgh, Montreal, and many other places; and calcareous marl is shown from Noisy River falls, where it covers the extensive slopes on both sides of the river, probably covering an area of 300 acres in the vicinity of the falls, with an average thickness of 5 feet; but the most important deposit is that on the great slopes of the Beaver River, in Euphrasia and Artemisia, where it is supposed to extend over more than a thousand acres, in the form of a strip on each side of the river. Under the head of mineral paints we have iron ochres of alluvial, and sulphate of barytes of Laurentian age. The barytes of Burgess and Lansdowne is derived from veins intersecting the Laurentian rocks. At both places the mineral, associated with calcspar, constitutes the veinstone of some of the lead lodes met with there. The vein yielding the Lansdowne specimen cuts Laurentian limestone. In an unsuccessful attempt to mine the vein for lead, it was ascertained that 28 feet of the lode, with a breadth of 27 inches, consisted of highly crystalline almost colourless barytes, yielding about 10 tons to the square fathom. The most abundant source of barytes in Canada, so far as is known, appears to be the veinstones of lodes carrying copper-ore on the north side of Lake Superior; these however belong to the Quebec group. In Canada this mineral is not as yet applied to any use, but in some parts of the United States it is refined and ground in large quantities for use as a paint.

Amongst the minerals applicable to the fine arts, foremost is the lithographic stone (Bird's-eye formation) from Marmora, where the Laurentian rocks are overlaid by 20 feet of unfossiliferous compact limestone, one of the beds of which is well adapted for lithography, and has been traced by occasional exposures from Hungerford to Rama, a distance of more than a hundred miles. Lithographic stone is also shown from the Onondaga formation at Brant and Oxbow.

On the minerals applicable to jewellery we shall not dwell at any length. We have agates, labradorite, albite (persisterite), orthoclase (perthite), jasper conglomerate, epidosite.

In the miscellaneous minerals we have feldspar (from a 20 feet wide Laurentian), sandstone for glass-making (Potsdam), moulding-sand (drift), and peat (alluvial). The peat exhibited occurs near Chambly, on the south side of the St. Lawrence, and was some years ago cut and sold as fuel, but the consumption was not enough to encourage the industry. As Canada is deficient in coal, when wood becomes scarce in the progress of settlement peat will gradually assume some importance as a fuel in many parts of the country. About 100 square miles of it extends along the south front of the Anticosti, and successive areas are met with on the south and north sides of the St. Lawrence. Large peat bogs occur between the Ottawa and the St. Lawrence, and there are many to the westward. The peat, which is sufficiently matted to hold together when dried, usually supports a growth of prairie-grass, or ericaceous plants, or of tamarac-trees. That which occurs in cedar-swamps is deficient in the fibrous plants which give cohesion, and it falls to powder when dried.

The Survey also exhibits an admirable collection of the crystalline rocks of Canada, arranged under these respective groups:—I. Laurentian. II. Huronian. III. Lower Silurian; and IV. Eruptive; accompanied by an excellent catalogue by Mr. T. Sterry Hunt. We cannot however give a special notice, however richly it deserves it, as we have already devoted a very considerable space to the Canadian collection; but the interest which attaches to it as representing that country, where, more than in any other part of our globe, the "bottom rocks" of the earth's stratified crust are most grandly exposed, warrants the fullest attention; and the numerous facts which are thus briefly but accurately recorded will be found hereafter of the highest value in considerations of the circumstances producing and attending the earliest history of our lowest life-containing and our earliest stratified azoic rocks. The Laurentian and Huronian rocks of Canada are indeed the grand title-page and preface to the ponderous and intensely interesting volume of paleontological geology.

Zollverein (Prussia).—Into the court of whatever country we go we are certain to find most instructive material. Unfortunately it wants, however, the previous knowledge of the geologist or mineralogist to be able to read the lesson to be learnt. It is not fanciful geology we must expect to find, although the Exhibition is not without some most interesting and instructive collections of fossils, and of plants and trees, and wood, birds, beasts and fishes, which go far towards unriddling many an organic fragment of the past, and many an artificial compound that goes to show how their rock-tombs were built up. But it is hard, honest, practical geology that the Exhibition teaches; it shows geology in its useful phases amongst the economic sciences of mankind. It is not according to their age or their organic contents that we find the specimens arranged, but according to their commercial value and importance.

First, then, in the categories of all nations comes coal, then the metals, then other substances, and so on from the most important to the most rare or least useful. In the Zollverein court there is an extensive suite of specimens illustrating its chief coal-fields, namely; those of the Hohe Veen, the Westphalian mountains, the Hundsrück, the Black Forest (Schwarzwald), the Teutobürgerwald, and the Wiehegebirge, the Thüringerwald, the Hartz mountains, the River Saale district, Erzgebirge in the kingdom of Saxony, Riesengebirge, and Upper Silesia. Descriptions and comparisons of these with our English beds would be highly instructive, did space permit; but it will be more interesting to pass on to those other coal-beds occurring in other formations, of which we either have no traces or only but little developed representatives. Proceeding upward from the carboniferous formation we find coal-seams (Lettenkohle) existing in the lower beds of the Keuper or new red marl on the eastern side of the Black Forest, between the Schwarzwald and Odenwald. In Würtemberg also these seams appear near Oedendorf and Entendorf, where they are used for the alum-works, and near Mittelbronn, where they are obtained for general burning purposes. Coal-seams likewise appear at other points in the lower part of the Keuper formation as well as in the upper, but not in a workable condition. The only places where available seams have been discovered in the Oolite formation are to the north of the Hartz Mountains, in the Prussian district of Wansleben and Neuhaldensleben; near Gnasleben and Brünnen, in the Duchy of Brunswick; and near Welfensleben, where the iron-pyrites which accompany the coal are used at the vitriol-works. The Wealden strata only appear on the north-western ridges of the Hercynian hills.

On the western edge of the Teutobürgerwald, in the district of Tecklenburg, Westphalia, a small seam of coal is seen in them on the road from Münster to Ibbenbüren, and two seams are met with near Tecklenburg, for a distance of 2 miles; the thicker one is 9 inches. In the district of Osnabrück, in Hanover, there are 4 seams, containing 8 to 10 feet of coal: three of the seams offer good caking coal, the fourth is impure. Their south-western continuation is found in the Prussian department of Minden, where 4 seams, equal altogether to 6 feet of coal, have been worked for a long time. On the northern side of the Wiehegebirge, and near the river Weser, there are seams of far greater importance and extent. In the department of Minden 2 or 3 seams are known, the lowest of which is 10 to 18 inches thick, and workable; affording caking coal in the eastern part, whilst the western is anthracitic. The seam has been worn on the right bank of the Weser 2 feet thick; but the most important workings are in the county of Schaumberg-Lippe. There are also coal-seams in the Wealden group, in the Duchy of Brunswick. North of Bückeberg there is a seam of 7 inches; and east of the Schaumburg seams appear in force, and one of from 8 to 44 inches, of bituminous quality, is worked. Seven seams appear near Münder, but are not workable; but this group is met with again in the Osterwald, consisting of 18 seams; three of which—27 to 40 inches—are workable; the middle one giving very pure bituminous coal. Two seams near Brünninghausen are worked: the upper one bituminous coal with much pyrites, 4 to 8 inches; the lower, 26 inches, gives a large percentage of ash. Near Mehle, 2 seams of 14 to 22 inches are worked; and a continuation of this group is found at Holzminden, where 3 or 4 seams give an aggregate of 17 inches of coal.

In the Cretaceous group a few seams of coal appear in the Cenomanian sandstone (next above the Gault), near Niederschöna, in Saxony; the upper one, 10 to 20 inches thick, was at one time the source of mining operations. Other small seams occur in different places, but are not workable. Four small ones appear in the Senonian (Upper Cretaceous) beds at Quedlinburg (in Magdeburg, Prussia); one of which has been worked at different times, although it contains only 12 inches of coal. The same coal appears in Prussian Silesia, near Wenig-Rackwitz, Ottendorf, and Neuen. Three seams are known in the two former places, measuring 38 to 44 inches; the coal is of good quality, and has been worked for a long time at the latter place. Coal also occurs at other places in Silesia, but not in any beds of any importance.

Next in importance to the true coals are the great Continental deposits of brown coal; and these have much interest in the eyes of geologists beyond their commercial value. Although brown coal, and particularly its earthy varieties, possesses a very inferior heating power to coal proper, yet, by affording an economical kind of fuel for common purposes, the workings in many places are very considerable. The distribution of the brown-coal beds in the Zollverein is quite different from that of coal, and their extent far greater. The various deposits may however be grouped in three divisions,—the western one, of the Harz and the Thüringerwald; the eastern one, the largest in extent and the most important, between the rivers Elbe and Vistula; and the southern one, on the edge of the basin of the Danube.

In the western group the brown coal of the basin of the Lower Rhine begins near the Dutch frontier, and continues thence on the edge of the older formations and through Eschweiler, Leimersdorf, and Corsdorf down to the Rhine. At most points but one seam is known, although there is reason to suppose there are others below it. A seam of 17 feet has been attained at Kalk, a place nearly opposite to Cologne, at a depth of 81 feet. Four seams, altogether 47 feet, are known between Deutz and Kalk; and the seam in the district of Bonn, between Cologne and Walberberg, is from 12 to 87 feet; between Liblen and Oberaussem it has a thickness of 66 feet, but the bottom of it is seldom reached. The thickness of the seam is not equally great at other points; for instance, at Noppenberg it is 40 feet, near Eschweiler 36, Düren 30, and 50 at Lissem. As corollaries to the basin of the Lower Rhine are the Neuwied basin, and the deposits at Dierdorf, Kempenich, and Eckfield.

Many varieties of brown coal contain a large proportion of iron pyrites, are therefore used for the manufacture of alum.

The brown coal of Düren is subjected, at the Eustachia works, as it is also at other collieries, to various economical purposes. Messrs. Doinet and Vonderbeck, the proprietors of those works, get from one pound of their brown-coal 15 to 20 feet of gas for lighting; 37·4 per cent. of coke, which is like charcoal, and much used in cupola-furnaces and for the rectification of spirits; and, finally, 4·5 per cent. of tar, with 35·5 per cent. of ammoniacal water. This tar yields 17·5 per cent. of photogene, 26·6 of greasing oil, 3·3 of paraffin, 16·9 asphalt, and 36·7 of kreosote.

This brown-coal seam is 12 feet thick. The same proprietors have other collieries; one of which, at Nabro, is excellent for the manufacture of alum, and at another, at Donctus, the coal has a thickness of 70 to 100 feet.

At the Bonn Mining Company's works, on the right bank of the Rhine, near Obercassel, oil is extracted from the brown coal worked.

The brown-coal measures of the Westerwald basin are situated in the Duchy of Nassau. They extend from Langenaubach on the north-east to Hartlingen on the south-west, a length of 16½ miles; or to the extreme outlier at Nentershausen, 23½ miles by a breadth of about 18 miles from Cautzenbrücken to Waldhausen; the most important part being the districts of Marienberg, Leiningen-Westerburg, and Härtlingen. These measures extend northward into the Prussian district of Altenkirchen. The superficial extent of this field is estimated at 66 square miles, and at the bottom of the brown-coal seams bituminous clays of great thickness are met with, and small seams of dysodile. Experiments have been made with a view of utilizing these beds in the production of mineral oil and paraffine.

There are brown-coal measures also which extend in larger or smaller basins from the Upper Rhine, near Dürkheim, to Wallensen, between the rivers Weser and Leine, over an interrupted area of 188 miles by 57 between Marburgh and Tiefenort. Three groups of measures occur: to the lowest belong the seams worked at Zell, Hasenbrücker Hammer, and Salzhausen. This bed offers about 53 feet of good, and 47 feet of inferior brown coal; but it diminishes towards Ostheim, where it is only 20 feet thick. The middle group comprises the seams of Kleinbach and Annerod, near Giessen, available, although not yet applied, to the manufacture of mineral oil, and the pyritiferous seams of Neuhof. Five to seven seams are known of an average thickness of 20 feet, increasing in some places to 80 feet. North of the Vogelsberg brown-coal measures, belonging to the lower group, extend as far as the Habichtswald. Besides these, there are others stretching out to the north and east. One seam, for instance, 100 feet thick, is worked near Frielendorf; another of ligneous and strong coal, 2 to 3 fathoms thick, near Ronneberg; a third near Ostheim; and others at Obermelsungen, Hesslar, Lammersberg, etc.

In the district of Cassel a vein of 2 to 3 fathoms of coal of very good quality occurs, partly of shining coal (Pechkohle), in the vicinity of basaltic dykes. North of the Habichtswald other deposits are known. A curious accumulation of vegetable substances in the older alluvium, which goes also by the name of brown coal, may be passingly mentioned as occurring in the Prussian district of Höxter, Westphalia. Seams of ligneous coal, 30 feet thick, are also known on the right bank of the Fulda, in the district of Cassel. South of Kaufungen the coal is 2 to 3½ fathoms thick. The same seams extend into the district of Witzenhausen, being at Gross-Almerode from 30 to 60 feet thick. Brown-coal basins also are found north of this district, in Hanover and Brunswick. Brown-coal measures, belonging to the lower group, are also met with at numerous places from the eastern side of the Vogelsberg to the Rhön mountains and the river Werra. The brown-coal measures on the western edge of the Rhön in Bavaria, are connected with the latter; these consist in part of dysodile, and may become important for the manufacture of mineral oils. Anthracitic brown coal is found at Wüstensachsen, and to the east on the more elevated parts of the Rhön mountain as far as Reupert. Hence the measures extend through Saxe-Weimar again into Bavaria, where a seam is known at Bauersberg. The eastern border of these measures stretches from Fladern through Saxe-Meiningen. Brown coal is met with to the north of this, in the districts of Geisa, Lengsfeld, Tiefenort, Vacha, and Gerstungen. Some specimens are exhibited by proprietors of collieries in Nassau, Hesse, and Bavaria.

The brown coal of the eastern group reaches all the way from the Thuringian basin, beginning at the foot of the Kyffhäuser to the extreme Samlandic part of the Baltic coast,—a length of 470 by a width between Domitz on the lower Elbe, and Franckenstein in Silesia, of 306 miles. The deposits form bays and basins on the eastern and northern edges of the hill-country, and spread thence under the diluvial formations of the low country. These deposits belong to the Oligocene division of the Tertiary period. On the left side of the Elbe, the brown-coal measures stretch far into the hills of the Hercynian system, forming separate bays, which are only partially connected with the large basin between Miessen and Magdeburg, where the course of the Elbe recedes more and more from the hills. The basin of Magdeburg extends from Helmstadt, in the Duchy of Brunswick, in a southerly direction into the Prussian district of Neuhaldensleben. In the district of Helmstadt the area is 18·8 miles by 4·7 miles, and the measures there have a lower group, which contains a seam of $3\frac{1}{2}$ fathoms, and an upper group, containing probably two seams—one of one fathom thick and bad in quality, and another above 70 feet thick.

The seam of the lower group is worked between Schöningen and Hötensleben, where it is divided into six beds, three of which give 36 feet of coal. Two seams near Strassfurth are from 24 to 40 feet.

Another basin, separated from the Magdeburg by the river Saale, extends into Anhalt-Bernburg, and far into the flat country, and forms the connecting link with the Thuringian basin by a great number of deposits of brown coal scattered over that area. In the neighbourhood of Halle the brown-coal deposits appear on the right bank of the Saale, and on the left, at Langenbogen, in the lake-district of Mansfeld, the seam has a thickness of 50 feet. The basin near Sangerhausen is very important; one seam, separated by intermediate rock into 5 divisions, giving an aggregate of 20 feet of coal.

In the district of Frankenhausen one seam attains the considerable thickness of 73 feet, and in the basin between that place and Espernstadt the coal attains to 84 feet in the middle, but decreases to 5 feet at the edges. Other deposits advance to the southern foot of the Kyffhäuser. Brown-coal measures extend from Zscherben, on the left bank of the Saale, through the Merseburg and Weissenfels districts, to Skortleben and Burgwerben, spreading out eastward into the district of Querfurt.

The brown-coal seams on the right bank of the Saale extend from Halle to Elster, where they are interrupted by a broad plain, and begin again near Wallendorf. One of the most important deposits covers a field of nearly $38\frac{1}{2}$ square miles, from Hilperitz to Naundorf and Pörsten. The greatest development of brown-coal fields occurs in the neighbourhood of Taucha, Wöbau, Köpsen, Wöhlitz, and Worschau, running out from this common centre in various directions. The measures of Wallendorf and Schladebach continue to the eastward into Saxony, where two seams are found near Priestaeblick, one 7 fathoms, the other about 6 feet thick. The same seam is found near Makrandstädt about 4 fathoms thick, and near Quesitz $27\frac{1}{2}$ feet thick, below two others of, together, $10\frac{1}{2}$ feet. More eastward, near Leipsic, a seam of about 2 fathoms has been worked since 1704. There is a second seam beneath it of 7 fathoms. Brown coal is worked on the rivers Pleisse and Elster, upward from Leipsic, near Cannewitz, Dehlitz, and Zöbigker; the deposit then continues as far as Groitzsch, where three seams are known, and from Pegau up to Oderwitz, close to the Prussian frontier, where two seams are won of 57½ and 39 feet. This deposit becomes still more extensive, where the Wyhra joins the Pleisse, 7 fathoms having been bored without reaching the bottom. More to the south, scattered deposits are found on the right bank of the Pleisse; also on the left bank of the Mulde, near Wurzen, and on the right bank at Grehritz, Skorditz, Leipnitz (3 to 4 fathoms), Skoplau, and Zschadras (7 fathoms), Lausigk up to Rochlitz. Dispersed basins are found between the Mulde and the Elbe.

There is also brown coal between the Elbe and the Oder. The latter measures appear in distinct veins at the edge of the so-called Lausitz hills, penetrating under the basin of Zittau, whence a connection with the important basin of Bohemia takes place across the boundary of the Zollverein. These spread out also into the low country at the foot of the Silesian mountains as far as Neisse, and again appear in the plain between Wittenberg and Dömitz, and even up to the vicinity of Stettin on the Baltic. In Saxony small measures are found near Ortrand, Camentz, and Bautzen; in Prussia near Jauer, Ratibor (2 to 3 fathoms), Buschwitz (2¼ to 3½), and Doberschütz (1¼ fathoms). A very important basin is met with in the district of Zittau; and an earthy kind of brown coal, called "sulphur-coal," is exported as a good manure to Bohemia and Silesia. From Zittau the brown-coal measures extend across the Prussian frontier, and follow the course of the Neisse in the department of Liegnitz. Very extensive seams are found at Schönberg (Lauban). One seam near Görlitz is 50 feet. Detached basins are known near Langenöls and near Hennersdorf, in the district of Jauer, containing 13 to 27 feet of coal, and to the east of Striegau showing 56 feet. These brown-coal measures can be followed from Rothenburg to the limits of Liegnitz and Frankfurt on the Oder. To the north the brown coal is again found near Sorau and at Lodenau, covering a wide expanse. There are two seams, the upper one of 80 to 85 feet. It is also met with to the west at Spremberg, and in the district of the Hoyerswerda, on the left bank of the Spree. These measures terminate in the Duchy of Anhalt-Dessau.

After a long break, brown coal is again found down the Elbe in the district of Perleberg; and seams are known in Mecklenburg, near the Prussian frontier.

The large basin of Freienwalde, on the Oder, is divided into several parts; the first extending over 22 square miles, from Freienwalde to Frankfurt; and others lower down in the neighbourhood of Schwedt, near Hohen-Zahden (south of Stettin), near Herzberg, and at Bucknow. More southern measures appear at Rauen and Petersdorf, and then near Streganz, the ancient monastery of Neuzelle, Einbeck, Gaemersdorf, and occupying a large tract of country in the Grüneberg district, where there is 15 feet of very excellent coal.

There are brown-coal measures also between the Oder and Vistula. Single basins far apart occur at Nieder-Kränig, near Finhenwalde, where the seams reach 27 feet; in Pomerania near Brietzig, Trampke, and at other places on the Baltic coast. There are measures near Landsberg, on the Warthe (Frankfurt); and brown coal is known near Landsberg and Kladow (7 to 20 feet), near Birnbaum, Zirke, Wronke, and Obornik (53 feet); near Trattin and Lässig, Grunow, Trebow (25 feet), and Zielenzig. At the latter place two seams occur together, 32 feet, partly brittle and solid and partly a woodlike coal. North-east of this is a seam 13 feet thick, at Gleissen, and to the eastward another, 35 feet, near Schermeissel; and two thick seams are worked between Schwiebus and Lugau. These deposits terminate at Padligar and Radewitsch, south of Züllichau. The basins of Köben and Steinau, on the left bank of the Oder, continue their course on the right bank, and are known from Bronau, near Guhrau, as far as Polnisch-Wartenberg and Trebnitz; the coal becoming more solid and in every way better as the seams diverge to the south-east, where it is frequently transformed into black pitch-coal (Pechkohle). It attains a thickness of 13 to 27 feet between Wersingave and Stroppin, and from Winzig to Glogau is from 5 to 10 feet thick. An entirely separate deposit should be mentioned near Dembiohammer, between Malapane and Oppeln, which was considered for a long time to be true coal. Seventy miles from the brown coal at Obornik on the Warthe, other deposits appear below the confluence of the Vistula and the Brahe, from the Fordon in Bromberg to Costelletz in Schwetz.

Brown-coal deposits on the east bank of the Vistula occur at Braunsberg (in Königsberg), and near Warniken and Rauschen on the Baltic coast.

In the southern group of measures many traces of brown coal have been followed up by diligent investigations along the southern edges of the Suabian and Franconian Jura, from Lake Constance to the Danube, and thence on its left bank as far as the so-called Bavarian forest in the beds of molasse. In the Grand Duchy of Baden good brown coal was discovered, but too thin to work. In Würtemberg also seams have been met with, but unworkable, except one of dysodile, 4 feet thick, near Randeck (in Kirchheim), which is used for the manufacture of photogene and paraffin. On the eastern edge of these deposits, in the Bavarian territory, important basins are formed, one near Sauforst, where the seam has a thickness of from 10 to 30 feet, yielding chiefly ligneous coal. Along the northern slope of the ridge of mountains in front of the Alps, in Upper Bavaria, brown-coal seams are everywhere met with, mostly of black pitch-coal, which cannot be coked, but which possesses the best qualities for puddling and reheating iron, and for domestic purposes. In the western part of this basin thirty seams are known on the southern slope of the Peissenberg, six of which are worked and have a total thickness of about nine feet. On the Pensberg forty-six seams are known, fifteen of which are workable. In the district of Auer one seam is worked, and one also at Eschelbach, in the district of Schongau. At a greater distance from the mountains three very thin seams are known at Irrsee, in the district of Kaufbeuren.

NOTES AND QUERIES.

Human Remains under Peat.—In the 'Quarterly Geological Journal,' vol. ix. 1853, p. 32, Mr. Gavey, F.G.S., stated that human remains had been found in blue clay, underlying peat and sand, at a depth of 9 feet 6 inches from the surface, in a railway cutting at Mickleton, in Gloucestershire. The geological evidences are detailed in Mr. Gavey's paper at great length. The late Professor Baden Powell, F.R.S., inserted a note on the subject in his 'Essays on the Philosophy of Creation,' 8vo, London, 1855, p. 501, in which he states, "Considering the very long series of physical events which thus must have occurred since the human remains were embedded, it becomes an important inquiry to endeavour to settle the probable relation of these various changes to any known epochs of geological action." This statement made by Baden Powell, although apparently borne out by the geological evidence, was impugned by A. Thomson, Esq., of Banchory, in the 'Edinburgh New Philosophical Journal,' vol. iii. 1856, p. 247. No satisfactory account of the skeleton has however been given. "The skull was small, but beautifully formed, *having the organ of veneration (!) well developed*," according to the observations made by Mr. Cooksey, surgeon, of Chipping Campden. The following measurements are given:—From posterior edge of foramen magnum to nasal bones, $15\frac{3}{16}$ in.; from one meatus auditorius to the other, over the crown, $13\frac{8}{16}$ in.; horizontal periphery, $20\frac{4}{16}$ in.

It would be very interesting to have further evidence respecting this discovery; and it is to be hoped that the skull may be placed in the hands of some practical ethnologist or cranioscopist. If it should offer any points of similarity to the "river-bed" skulls, another link in the chain of evidence would be procured.

REVIEW.

Esquisse d'une Description Physique et Géologique de l'Arrondissement de Montbéliard. Par Dr. Ch. Contejean. Leipzig: Rothschild, 1862.

The physical and geological description of a district, although it may not have for general readers so great an interest as works of a more extended and diversified kind, forms nevertheless one of the many solid blocks of which the noble building of geological science is constituted. It is with the greatest pleasure we see these important repertories of valuable details multiplied day by day. Usually they are the work of some devoted individual who has worked, *con amore*, in the place of his birth, or of his daily labours, and often they are printed at the expense of his private purse. Often some publisher is found to take up some of this class of books as a business transaction, and such cases are gratifying, for it shows a great and wide-spread, if not indeed a public, interest in our science.

The work before us was begun at the solicitation of the Society of Emulation of Montbéliard, who desired to furnish their contingent to the scientific description of France demanded of the French learned societies by the Ministerial circular of the 1st of June, 1860. M. Contejean is the *préparateur* of the Museum of Natural History, of Paris, and, at the distance of a hundred leagues away, it did not seem the easiest task to write the geology of a district; but he yielded to the wishes of his colleagues, feeling that his many botanical and geological explorations of his native soil, so fresh in his memory, would enable him to give a sketch of all the essential details. The book thus produced is divided into four subjects:—I. The physical description of the arrondissement—its situation, its elevated regions, mountains, rivers, lakes, marshes, and peat-bogs. II. A geological description, comprising notices of the Triassic, Jurassic, Neocomian, Cretaceous, Siderolithic, Molasse, Tertiary, and modern deposits. III. The Orography of the district. IV. General considerations. It is illustrated with a map and two plates of very instructive sections. The divisions and subdivisions of the various formations are given with conciseness, but every necessary detail. It may be useful to English geologists to epitomize these very briefly for the sake of comparison with our English beds, leaving those who desire fuller information to obtain it from the book itself, which offers an admirable model for the production of similar works in our own country. Such works on local geology are too few with us, and are generally too poor, both in ability and information, to merit regard; it is most commendable therefore to promote the desire for this class of productions on every occasion that presents itself, and a better model for a simple geological sketch could not be taken than the one before us.

The arrondissement of Montbéliard is situated at the extreme frontier of France, near the Vosges, in a depression which separates those mountains from the northern Jura. It consists almost entirely of the Jurassic formation; but outcrops of the Triassic and masses of other rocks are however met with.

The Trias is divided into *Grès bigarré* (variegated sandstone), *Calcaire conchylien* (Muschelkalk), and *Marnes irisées* (Keuper).

The Jurassic formation offers eight subdivisions—the Lower, Middle, and Upper Lias, the Inferior and Great Oolites, and the Oxford, Coralline, and Kimmeridge series. The base of the Lower Lias is a yellowish-white quartzose sandstone, four to five metres thick, full of casts of *Cardinia* and other bivalves, and corresponding to the Grès d'Hettanges. Over this follows the dark grey *Calcaire à Gryphées arquées*, attaining the thickness of ten to twelve metres. The Middle Lias presents, at its base, grey or blue marls and dark-coloured, marly, fragile limestones, slightly schistose; these are the *Marnes à Gryphæa cymbium*. The second group is formed of blue limestone, disposed in nodules in regular beds, alternating with narrow beds of marl—*Calcaire à Belemnites*. The third group, the *Marnes à Ammonites margaritatus*, consist of dark grey shaly marls. The *Marnes à Plicatules*, the fourth and last group of the Middle Lias, alternate with marly limestones. They are always micaceous and sometimes sandy. The thickness of the whole division is about thirty metres. The Upper Lias is divided into three groups, the *Schistes bitumineux*, the *Marnes à Trochus*, and the *Grès supraliasique*. The first consists of very friable, argillaceous schists, highly impregnated with bitumen; the second are firm grey or whitish marls; and the last is formed of nodules and fine layers of very friable sandstone, very micaceous, alternating with sandy clays charged with mica, and known as the *Marnes micacées*. The thickness of the division is from twenty to thirty metres. The principal fossils in the upper beds—*Ammonites insignis*, Schubl.; *A. primordalis*, Schl.; *A. bifrons*, Brug.; *Trochus duplicatus*, Sow.; *Leda rostralis*, Lam. sp.; *Nucula Hammerii*, Defr.; *Astarte Voltzii*, Hoen. The Inferior Oolite commences with reddish or yellow limestones, enclosing regularly stratified beds of hydroxide of iron, the *Oolithe ferrugineuse*. Above this is the *Calcaires à Entroques* (entrochital limestone). Then, again, the *Calcaires à Polypiers*, enclosing siliceous nodules. The thickness of this group, over forty metres in the Jurassic chains, is considerably reduced at the northern extremity of the arrondissement. The Oolitic iron is an excellent mineral, and supplies a great many of the factories of Franche-Comté. There are important mines in it worked by the Compagnie des Forges from Audincourt to Dampjoux, near the mouth of the Barbèche. The Entrochal limestone furnishes a building stone of very excellent quality, which is almost exclusively employed at Besançon by the military engineers. The Great Oolite presents three divisions constant in the Jura, but elsewhere artificial, and more distinct in their mineral character than by their faunas. These are the *Marnes à Ostrea acuminata* (Marnes vésuliennes of Marcou); the Great Oolite, properly so called, and the *Dalle nacrée*. The first is a blue marl, made up as usual of those little oysters from which it takes its name, and is sometimes twenty metres thick. The Great Oolite is a very massive limestone, the upper part of which has been, rightly or wrongly, considered by some Continental geologists as representing our Forest Marble. The *Dalle Nacrée* (Nacreous Marble) is a small limestone series enclosing at its base subordinate beds of clay. The principal fossils of the *Dalle Nacrée* are *Ammonites macrocephalus*, Schl.; *Am. sub-buckeriæ*, D'Orb.; *Pholadomya buccardium*, Ag.; *P. Vezelayi*, Laj.; *Lyonsia peregrina*, Phill., sp.; *Lavignon mactroides*, D'Orb.; *Gervillia acuta*, Sow.; *Ostrea acuminata*, Sow.; *O. costata*, Sow.; *Rhynchonella concinna*, Sow., sp.; *R. Lieteni*, D'Orb.; *Terebratula digona*, Sow. In the *Etage Oxfordien*, M. Contejean includes the Callovian and Oxfordian Étages of D'Orbigny, and consequently in the Montbéliard region he admits in that group the *Fer Sous-Oxfordien* (Callovian), the *Marnes Oxfordiennes* (Oxfordian), and the *Calcaires à Sphærites* (Argovian).

His *Etage Corallien* is the Étage Corallien of D'Orbigny, less the *Calcaires à Astartes.* It begins with the *Argilles à Chailles;* to these succeed the *Calcaires Coralliens* proper, which in the Haut-Jura exceed a hundred metres in thickness, and it is terminated by the Coralline Oolite (*Oolithe Corallienne*). The Étage Kimméridien is made also by M. Contejean to include the Étages Kimméridien and Portlandien of D'Orbigny, and it is this group which most especially occupies the general surface of the Montbéliard arrondissement. The four divisions of this étage are the Astartien, Ptérocerien, Virgulien, and Nérinéen.

Between the Portland dolomite and the lowest Neocomian beds there are intercalated, in many localities, beds which have exercised the wits of many geologists, and have given rise to much controversy. These are the *Argiles des Villiers*, a small freshwater formation, considered by some to belong to the Jurassic period, corresponding to the Purbeck beds, and by others as representing the Weald Clay; whilst others attach them to the Cretaceous Formation. The author expresses no opinion on this point, but points out the occurrence of these clays at Villiers-le-Lac, near Morteau, and as occurring also generally at the base of the Neocomian deposits in the canton of Russey, in very variable thickness, but on the average about 10 metres. Their colour is dark grey, almost black. The fossils are rare and badly preserved. M. Lory has noted *Physa Bristovii*, Forbes (*P. Wealdiana*, Coq.), *Planorbis Lorii*, Coq., *Corbula alata*, Sow., and undetermined species of *Paludina*, *Lymneus*, and *Cyclas*.

The Cretaceous rocks are represented by Neocomian limestones, surmounted by bands of limonite-iron—the *Valenginian* group; or as M. Contejean prefers to call them, the *Calcaire à Limonite*, and the *Marnes de d'Hauterive* and the *Calcaires de Neuchâtel.* The *Calcaire à Chama* (Negonien, D'Orb.) does not exist in the arrondissement, nor are any of the Upper Cretaceous beds to be met with.

The *Terrain Sidérolithique* is another small formation which has occasioned discussion as to its origin, and the place it ought to occupy in the geological series. It consists of clays, sands, and grains of iron, confusedly heaped in the fissures and open depressions of all the Jurassic beds. The iron is worked in numerous places, and some of the mines are very important.

The Molasse extends from the north-east of Montbéliard over the territories of Sochaux, Exincourt, Etupes, Brognard, Dambenois, and Allanjoie. Isolated by erosions, it forms low and rounded hills. At Montaineau the Molasse begins with strong beds of conglomerates of rounded pebbles belonging to the Jurassic beds, and often preserving their fossils. These pebbles agglutinated by a calcareous sandy cement, penetrated by grains of iron from the "terrain sidérolithique," are so closely packed that the prominences of some make indentations on others, the cavities corresponding as when a hard substance is pressed into a softer. This phenomenon has often excited attention, both in this locality and elsewhere, and has recently been receiving the careful and acute attention of Mr. Sorby, from whom we are likely to receive shortly a very interesting explanation of its cause and the manner of action. Above these massive conglomerates, beds of "pudding-stones," alternating with sands and clay, occur; and finally, in the upper part, is homogeneous sandstone, or, properly called, Molasse. The fossils are rare and badly preserved. In the upper sandstone are impressions of mytilus, cardium, and some fragments of oysters, and bones of the sea-cow or lamantin. Beds of freshwater limestone, highly charged with silex, occur at Dampierre, Chatenois, and other places, and contain snails, lymneas, paludinas, etc. At Chatenois these beds are more than 8 metres thick. The relationship of these freshwater deposits with the marine beds of the Molasse is very difficult to make out.

The hills and plateaux of the lower regions are covered over the greater part of their surface by patches of diluvium, which augment in thickness towards the plain of Alsace. To the south, these deposits invade the plateaux to the height of 450 metres. The diluvium consists of sands, pebbles, and clays confusedly mixed, without assortment or of visible stratification. The sands and pebbles are of Vosgian or Hercynian origin, and are of crystalline schists, granites, syenites, quartzites, porphyries, and ancient sedimentary rocks reduced to fragments varying from a grain to the size of the head. As the Vosges are approached these débris become more numerous and larger. The bones, and particularly the teeth, of *Elephas primigenius* and *Rhinoceros tichorinus*, characterize these deposits.

There are within the arrondissement numerous caverns and osseous breccias. The best known are those of Vaucluse, Mancenans, and St. Julien; the latter 200 metres above the bed of the Dessoubre, and the entrance to which is absolutely inaccessible without a ladder. Up to the present time no human remains have been found in any of these caverns. The ordinary mammalia are bear, hyæna, cave-lion, several kinds of deer and ox, some rodents and insectivora. Some bones of birds have also been found. In the escarpments of the Château de Chatillon, near St. Hippolyte, fissures exist partly filled with osseous breccia, amongst the fragments in which M. Duvernoy has recognized bones of the cave-bear.

Erratic blocks are also very frequent, scattered over the heights and ridges of La Haute-Montagne. These are of crystalline schists, protogene, black-limestone, and other rocks coming from the Alps of Monte Rosa.

The turf-bogs are formed almost entirely of mosses of the genus *Sphagnum*. The gravel-beds contain often blocks of considerable size, and the bones and teeth of beaver, small rodents, and insectivora, which have long since been extinct in the district. The superficial deposits often present remains of vegetables and minerals such as now exist, as also products of human industry.

M. Contejean's book consists of ninety-two pages, and the brief inkling we have given our readers of the contents of a few is an earnest of the valuable and interesting matter contained in that still larger proportion which space prevents us from noticing at all.

DRACÆNA BENSTEDII, König.

From a Specimen in the British Museum, presented by Mr. Bensted.

S. J. Mackie, del.

THE GEOLOGIST.

NOVEMBER 1862.

THE "DRAGON-TREE" OF THE KENTISH RAG.

Mr. Bensted, in his 'Notes on the Geology of Maidstone' (p. 336) has referred to certain vegetable remains from the Kentish rag-beds of his quarry, under the title of *Dracæna Benstedii;* and under this name the specimen stands recorded in Professor Morris's Catalogue. The entry there is "*Dracæna* (Linn.) *Benstedii*, König, Mus. Brit., L. G. S., Maidstone," but the name of the class is not given, whether by omission or from some special reason we are not aware. The recent *Dracænæ* are referred by botanists to the Liliaceæ, and the best-known species is that which supplies the fine pigment used by house-grainers, and commonly known as "Dragon's blood."

The Dragon-trees form a most extraordinary and celebrated genus of monocotyledonous vegetables. They belong to the Asparagus family; and with the appearance and interior organization of the Palms, they are said to approach them still nearer in their fructification.

All the kinds are said to delight in arid soils, and to flourish on the shores by the sea, ranging from that level to eight hundred or a thousand yards on the mountains.

Twenty to twenty-five species are recorded as natural to inter-tropical regions—India, China, the islands of the Pacific, Cape of Good Hope, and the coast and islands of South Africa. One only exists in the northern part of the American continent, in the far north of Canada, or on the borders of the icy regions of Hudson Bay.

There appear to be, as far as we are aware, no published sections of their structure, nor any particularly valuable descriptions for the geologist. Some monographs do exist of somewhat ancient date, namely, Crantz, 'De Duabus Draconis Arboribus Botanicorum,' 4to, Vienna, 1768; Berens, 'De Dracone Arbore Clusii,' 4to, Göttingen, 1770; Vandelli, 'De Arbore Draconis seu Dracæna,' 8vo, Olisipone, 1768; and Thunberg, 'Dissertatio de Dracæna,' 4to, Upsala, 1808. These are all the special works which have come under our direct notice. Various accounts, however, are scattered through various books of travel and of expeditions; and especially any one who wishes to work out the subject will find accounts and admirable photographs of the great dragon-tree of Orotava, and many others, in Professor C. Piazzi Smyth's 'Teneriffe.' This Orotava-tree is reputed to be 6000 years of age.

"Poor old tree, whose trunk was hollow when Alonzo del Lugo and his *conquistadores* in 1493 established the Spanish authority here, and turned the bark into a chapel for holy mass after it had served Druidical purposes amongst the Guanche tribes for ages. How frail is it now! A storm wrenched off an arm; and more recently certain Goths hacked an immense piece out of the thin wall of hollow trunk for the Museum of Botany at Kew. . . . Sixty feet high above the ground at its southern fork; forty-eight feet and a half in circumference at that level, 35·6 at 6 feet above, and 23·8 at 14·5 feet above, or the place where the branches spring out from the rapidly narrowing conical trunk—this Dracæna cannot compare with the real monarchs of the forest for size. And we must remember that it is no proper tree with woody substance; it is merely a vegetable; an asparagus stalk, with a remarkable power of vitality and an equally eminent slowness of growth: it is this last, indeed, not its size, which has gained it the credit of being the oldest tree in the world. Let us take note of the chief characteristics. First, the immense uprearing of long, naked, root-like branches, and the pyramidal outline of the trunk. The leafage makes no very sensible appearance; there is the typical tuft at the end of each branch, or rather stem; but the miniature palm-trees have been growing for ages without bifurcation, extending only in length, nothing in breadth. At the point of junction of two or more a thickening of the lower branch begins, and occasionally may be seen one or two withered radicles hanging loose; for they have failed to enter the bark, and work their way down to the ground. So many of them however have done this, that while the simple stems are smooth or marked only by shallow, transverse indentations of footstalks of past leaves, the compound stems are deeply corrugated longitudinally, and the trunk more markedly still, with an evident tendency in every wrinkle to divide continually as it descends. When once a stem has branched its life seems to have departed, being replaced by the lives of the several young trees of its kind left growing on its summit, and whose roots, entering the bark, and encasing the stem on every side, conceal its slowly withering corpse from the light of day. Ages pass by; the young trees after flourishing die in their turn, each producing two or more new ones mounted on their summits; . . . the inosculating roots, which had decorously concealed the death of their parent stem, feeling the requirements of the growing family above, expand their circle of support below; the trunk that had been cylindrical becomes a broad-based cone. An opening is made on one side. We look in and find a mere hollow. In the centre of that void there stood the original tree; it is gone now, as completely as any of the early progenitors of annuals growing in our gardens. Hence some explanation of the hollow interior of the great Dragon-tree. It is a physiological necessity."

As the Maidstone specimen in the British Museum has never been published, we give a representation of the most characteristic part in Plate XXII. Mr. Carruthers, of the Botanical Department of the British Museum, is disposed to think that it is the bifurcation of two branches. The specimen is no more than the cast in Kentish ragstone of the original mould of the exterior in that stratum, and is valuable only as showing those ribbings and small and peculiar pittings on the surface which accord with the like but fainter ribbings and pittings on the surface of the recent *Dracæna draco.* The fragment figured is one-third natural size, and one of several pieces, of which another measures 11 inches in length by 4½ in diameter; a third, 16 inches by about the same thickness. In these, portions apparently of cavernous wood are found within the exterior rim of bark, and at places seem to show structure. The opportunity has not yet been afforded me of examining this structure minutely, but I hope Mr. Henry Woodward will accede to my wish, that a section of the specimen should be made, and that he will furnish us with some account of its peculiarities. I draw attention to this specimen, for all the pieces are parts of the same branch, not with any wish or purpose of disputing its right to its generic name,—notwithstanding that rests on those very fragile grounds, mere external resemblance,—but because at present it seems to stand alone, as representing the Liliaceæ in the Secondary period, and we have no record of this class that I remember in any of our Tertiary deposits.

It might be well however to look to the Pandanaceæ, or screw-pines, before even, on the evidence before us, it is accepted as certain that this Greensand fossil rightly belongs to Dracæna. The recent *Pandanus amaryllifolius*, Roxb., the *P. odoratissimus* of Eastern Asia, and an undescribed species collected by Mr. Robert Brown, have all, more or less, somewhat similar but perhaps harsher and coarser ribbings and pittings; and it should not be forgotten, that from the Inferior Oolite of Charnworth in Dorsetshire we have the *Podocarya Bucklandi* referred to the Pandaneæ in Morris's catalogue, but placed by Professor Phillips, in his 'Manual,' with the Cycadeæ. There is another reason for looking to this class, namely, the conical fruits occasionally met in the Lower Greensand beds, and which, if they belong to either class, are more like Pandanaceous fruits than Liliaceous.

As I have found fragments of similar cavernous wood in the Greensand of Folkestone, it is probable many more specimens may be by diligence obtained; and my impression is, that a large tree I once saw split out like a picture on the surface of an enormous block of ragstone in Mr. Bensted's quarry was a nearly perfect specimen of the *Dracæna Benstedii*, or whatever other genus this specimen may be proved to belong to.

We have before drawn passing attention to some of the plants of the British cretaceous rocks, and we wish again to do so now. It is an unworked mine full of promise, and every labourer in it will meet reward.

ON THE RESTORATION OF PTERASPIS.

By the Rev. Hugh Mitchell, M.A.

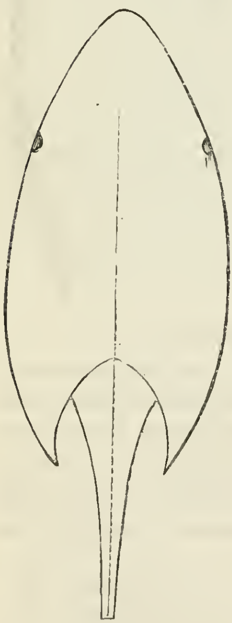


Fig. 1.

In the year 1860, when engaged in drawing up a list of the fossils known to occur in the Lower Old Red Sandstone of Scotland, we had occasion to remark that, with the exception of the Pteraspis, we had found in our northern rocks the various fossils of the equivalent beds in England, and many others besides, indicating an extensive piscine fauna in that epoch of geological history. We have now to remove that exception, for Pteraspis does occur with us. Some very fine specimens have recently been found in our Scottish rocks, and from their examination we are not only able to discern that fragments which have been many years in our possession, and which we could not refer to any known fossil, belong to that palæozoic fish, but we are also encouraged to attempt the restoration of the remarkable buckler, composed of solid bone, in which this ancient denizen of the deep was encased.

Figure 1. In the construction of this diagram three fossil specimens have been employed. These specimens are similar in their proportions and in the method of their pre-

servation, and their exact measurements have been followed in the figure. The first specimen, used for this diagram, exhibits very beautifully the form of the shield with the terminal horns, and the distinct eye-sockets. The eyes are placed on the margin of the shield, and their impression is also seen on a cast in the stone of this specimen. The second specimen is the prolonged central termination of the shield, which has been broken off at the ridge which terminates on either side in the horns. The third specimen shows the junction of this central prolongation with the shield. All the three specimens have a high central ridge, and still retain something of the graceful outline of the living form. As preserved in the stone these specimens show only the nacreous layer, the other component layers of the bone of the Pteraspis having perished in their case.

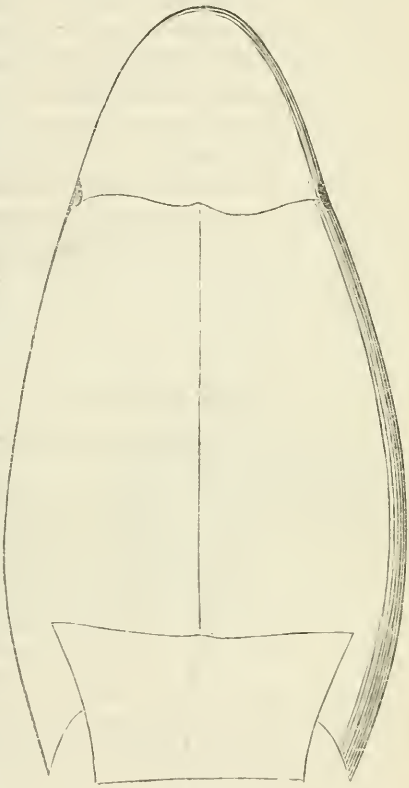


Fig. 2.

Figure 2. Two specimens have been employed for the construction of this diagram, the one a piece of solid bone, and the other a cast in the stone of the under surface of the dorsal shield. They are apparently the relics of individuals of the same species and even size; and we have again followed their exact measurements in the figure. The specimen of solid bone exhibits the external aspect and general outline of the shield, and is especially valuable as showing the form and position of the horns of the shield. It will be observed that these are not the prolonged cusps of the Cephalaspis, or at least of the *Cephalaspis Lyellii.* The cast shows the marks of the eye-sockets, and exhibits traces of the central ridge of the shield. The ridge, however, is a low one in comparison of that in Figure 1; and we have hitherto failed to discover the central prolongation or termination of this larger or adult form.

Figure 3. This must be understood to be very conjectural; and although three of the plates are copied exactly as they occur in the stone, their arrangement and their function must be considered so far

a guess. We regard the whole as forming an abdominal plate, composed of different pieces, joined by sutures, and which covered the under side of the head and, it may be, part of the body of the Pteraspis. The pieces we possess are numbered in the diagram 1, 2, 3, and the others have not occurred to us. In 1 we cannot discover any trace of the eye-socket, which, had this been the anterior portion of a dorsal plate, ought to have been displayed; but in 2 there is a round orifice, to which a sucking apparatus might have been well attached. If this interpretation be correct, and be confirmed by further evidence, then, at length, we have reached the method in which the Pteraspis and its kindred Cephalaspis sought and received their food in the waters. The separate plates seem to be bone, composed like that of the cephalic buckler, and were apparently joined together by deep sutures. The bone covering the upper surface of the head presented a solid mass to any opposing object; but that covering the under surface, as less exposed, was formed of different pieces, and thus flexible wherewithal. And we have observed that Plate 1 covers Plate 2 by a deep marginal socket; so that the plate to which a sucker might be attached could not be torn from its place without the resistance of the other.

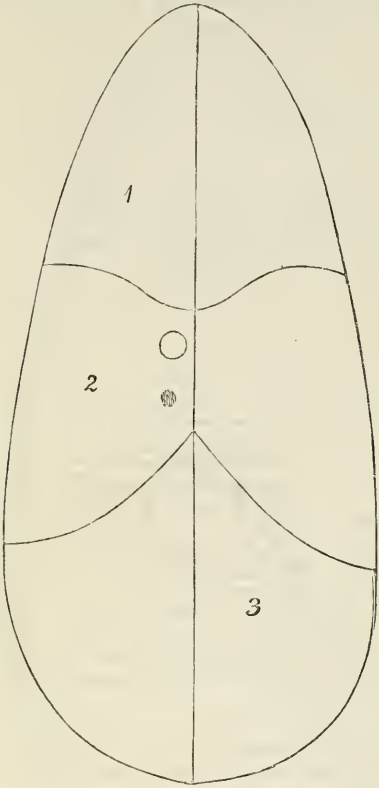
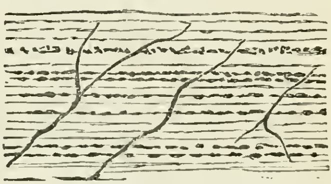


Fig. 3.

CORRESPONDENCE.

Origin of Flint Veins in Chalk.

Dear Sir,—A short time since a paper appeared in your publication reviewing the various theories concerning the origin of the chalk flints. No notice was then taken of a theory which, to my mind, explains the origin of flint better than any of those theories which have as yet been advanced. Before explaining this theory I will allude to a phenomenon which is apparent in nearly every large exposure of flint-bearing chalk. *Seams of flint, often not more than an inch in thickness (sometimes much less), may be seen in the chalk, running at almost right angles to the lines of stratification.* From these seams it is possible to detach slabs some feet in superficial area, but only an inch or so in thickness. Now, I ask any person who has the slightest knowledge of the nature of deposition and stratification, whether such a mass as I have described could have been formed at the bottom of the sea round a nucleus of any description, and then have been deposited with the chalk in such a position, viz. at a considerable angle to the lines of stratification. I think that the answer will be in the negative, and that we must have some other theory than that held by Dr. Bowerbank to account for the presence of, at any rate, such masses as these. You have probably noticed the seams, to which I allude, yourself, as they are abundant everywhere along the south-western coast of England. My attention was first drawn to them in the cliffs between Brighton and Rottingdean, where many and striking examples may be seen. The only theory which can explain these occurrences, and which is sound as far as I can see in other respects, was held, I believe, by the late Professor Henslow, who considered that the chalk flints had been formed after the deposition of the calcareous stratum in which they are found, during its elevation from the sea, by the percolation and concentration of water, highly charged with silica, into cavities left by the decomposition of animal and vegetable matters which had been enclosed. In the process of drying, fissures would naturally form in the chalk, in which the siliceous water could accumulate and leave its deposit of flint, in the same manner as it had accumulated and formed "nodular" masses in the cavities left by the decomposition of sponges, echinoderms, mollusks, etc. I think it is also probable that the gases formed by the decomposition of these organic bodies would enlarge the cavities formed in the yielding chalk; and might not some chemical affinity or exchange also have assisted in the elimination of the siliceous particles from the water?



I should be glad to hear from yourself or correspondents, either facts which will tend to support this theory, or some other hypothesis which will better explain the occurrence of these continuous seams of flint. I enclose you a sketch of the cliff with flint seams, and remain,

Yours, etc.,

September 8th, 1861. SILEX.

The Red Sandstone Blocks of Dunmanway.

SIR,—The beautiful representation of the Old Red Sandstone block of Dunmanway, county Cork (given at page 248, 'Geologist' for July) gives rise to the following suggestions:—

Dunmanway's Old Red Sandstone blocks stand forth as rocks
Of *water*-markings; not rubs and jolts of ice-blocks;
Water went round to mark them.

The ripple-marks left by undulating waters
On limestones in Lake Killarney, and other quarters,
May still be seen in progress.

Yours faithfully, A Subscriber.

6th August, 1862.

[If our correspondent is not pleased with his communication being set up by our compositor as a poetical effusion, he has no one to blame but himself; for, not sending us, in confidence, his name and address, we could neither send him a proof nor ask his instructions. We are continually annoyed by this reprehensible conduct, and many things worth printing are often, for this reason, consigned to our waste-paper basket. The post-mark on this communication is Ryde, but we should only give the Dead Letter officers trouble if we posted a letter "To Subscriber" there. It would be a worse address than the memorable "John Smith, England."—Ed. Geol.]

The Kirkdale Cavern.

Sir,—In the September number of 'Macmillan's Magazine' there is an article by Mr. John Taylor, concerning this place, upon which, as I take it to be a very important one (thus *greatly* differing from the majority of geological papers, which are combinations of the most obvious facts and the most *unobvious* speculations), I am desirous of making a few observations. That it presents an agreeable contrast to the views of some of "our best authorities" in geology, no candid person can but admit; but, at the same time, I look upon it as perhaps the *commencement* of new inquiries, which probably will effect the demolition of similar irrational and far-fetched explanations.

That any individual could consider the one in question, and yet maintain the doctrine of Buckland, could, I think, only be accounted for on the ground of faith in this distinguished geologist,—the facts alluded to by Mr. Taylor being absolutely *crucial* as regards the *conclusion* drawn from them. We have here an example of an *apparently* geological phenomenon which is really an *historical* one, and of the utility which the knowledge of ancient customs is in the explanation of physical phenomena. In the present case, without this knowledge the explanation would have been only a speculation; but as the explanatory circumstance is *known* to have been a fact, and it is not possible *otherwise* to account for the phenomenon, there is as much certainty as can be obtained concerning any *unseen* phenomena. In this sense the conclusion is warranted, or crucial, from the facts brought forward. I have here, of course, presumed that the alleged facts are such, concerning which, as far as I can understand, no discussion can be raised.

J. Alexander Davies.

[We are sorry to read the opinion formed by our correspondent of the antiquated, absurd, and ignorant article in 'Macmillan's Magazine.' Want of space prevents comments on our part upon it in the present number, but we shall refer to the subject again. Two excellent articles in the 'London Review' may, in the interim, be perused with advantage by Mr. Davies and those who concur in his appreciation of Mr. Taylor's untenable article.]

GEOLOGICAL NOTES IN THE GREAT EXHIBITION.

Italy.—The Natural History Museum of the Royal University of Pisa exhibits the following plaster and wax models of fossils:—*Mastodon Avernensis* (jaws and separate teeth); *Elephas meridionalis* (jaws, part of upper jaw, teeth); *Hippopotamus major* (part of jaw, teeth); *Rhinoceros Etruscus* (skull, part of jaw, part of upper jaw); *Lutra Campani* (almost entire skull); *Amphicyon Laurinense* (part of jaw); *Sus charoides* (two portions of jaw); and several other interesting fossils are exhibited in the Italian department.

The following tables of the number, produce, and working staffs of the Austrian coal-mines, eliminated from the minute details given by the Austrian Geological Survey, will be viewed with some interest, not only in respect to the various manufactures which of late years have been carried on at the expense of coal proper, but in respect also to the total quantity raised in comparison with the annual enormous yield of our own coal-fields.

It would have been a most interesting thing to have worked out minutely the comparative values of the various kinds of bituminous minerals in respect to manufactures; but the absence of any official or reliable information renders such a task very difficult, while the carelessness of labelling of some exhibitors, and, we almost fear, the intentional obscurities of the specimens of others, leave so many chances of error to any writer attempting to deal with the Exhibition samples of this class as would make the boldest and most anxious votaries of science hesitate to go fully into the subject. The comparative values of bituminous shales and coals proper in the actual commercial manufacture of paraffine, the origin of rock-oil, whether the latter is of the same age as the beds which contain it, or whether such beds from a peculiar basin-like condition are only mere receptacles of a product of very various dates of formation, are all interesting questions. The effect of former litigations on the first very important topic is still most bitterly felt in the retardation and obscuring of a subject of real scientific and commercial importance; while the still common careless or wilful misuse of the term "coal"—a secondary consequence also of that baneful influence—disfigures the writings and arguments of some of our eminent geologists, and leads to the utmost confusion in the public as to the real nature of the minerals which are truly serviceable for that and various other manufactures. The true type of coal is undoubtedly "Newcastle coal:" the so-called cannel "coals," the Wemyss "coal," the Wigan "coal," and Boghead "coal" are simply misnomers; and we cannot wonder that parties interested in the manufacture of paraffine should pass strong comments when they see samples of one thing exhibited under the name of another, as Mr. Campbell has done in the last number of the 'Mining Journal,' on the sample exhibited by Mr. James Young, of Bathgate. And certainly with respect to that gentleman's specimen of "Boghead Coal,"—another name only for the memorable "Torbane Hill Mineral,"—the Boghead "coal" being the Torbane Hill Mineral dug from the portion of that shale-field leased by Mr. Gillespie to the Messrs. Russell of litigation notoriety,—it does indeed bear no resemblance to that substance, of which some hundred-weights of specimens have passed through our hands as *the* substance from which the Bathgate paraffine was made. In the foreign courts the same obscure use of the term "coal" is so common, that, combined with the absence of any proofs that the samples exhibited are *actually* samples of the articles used in the manufactures to which they are assumed to relate, although really anxious to view this important topic in a purely *scientific* light, as to the nature of the origin of the various commercial bituminous products, we reserve, at least for the present, our notes on the subject, to seek for the fullest information from every reliable quarter—not with any view, and still less any wish, to enter into or bring up again a controversy the embers of which it is evident are still burning, but from the desire which a man of science naturally feels to investigate an unresolved problem, and to turn the knowledge he gets to the advantage or instruction of his race.

BOHEMIA.

Specimen Exhibited.	Place or Name of Mine.	District.	Owner.	No. of Seams.	Thickness. Feet.	People Employed.	Steam Engine.	Quantity of Coal. Ash.	Water.	Coke.	Caloric Units.	Tons raised.
Peat	Eggletschlag	Budweis	Prince Schwarzenberg	1 (Moor)	5 to 11	54 to 70						
,,	Julienheim	Gratzen	Count Bugnoi	1 (Moor)	4 to 14							
Brown Coal	Dux	Teplitz	Countess Waldstein	1	57 to 60	20	1	2.2	17.8	. .	4,486	5,500
,,	Oberleutensdorf	Brüx	Count Waldstein	1	72	10	. .	3.7	17.6	. .	4,565	2,600
,,	Wiklitz	Karbits	Count Westphalen-Fürstenberg	1	48	62	2	. .	. .	. .	. .	41,000
,,	Hostomitz	Bilin	W. Ehlig	1	60	10	1	4.1	18.1	. .	4,136	3,100
,,	Dallwitz	Karlsbad	F. Urfus	1	30	24	. .	. .	. .	. .	. .	2,800
,,	Prödlitz and Herbitz	Assig and Karbitz	J. A. v. Elterlein	1	30	40	3	1.2	12.4	. .	4,158	15,600
,,	Türmitz, Schönfeld, and Randnitz	Aussig, Karbitz, Teplitz	Count Nostitz-Rienek	1	6 to 51	140	3	3.9	20.6	. .	4,441	55,000
,,	. . . . .	Karbitz	"Saxonia"	1	48	. .	4	5.0	21.4	. .	129	39,030
,,	Ottowitz	Karlsbad	Ch. Knoll	2	30	14	1	5.2	22.5	. .	3,100	1,300
,,	Salesl	Leibmeritz	Dr. Geissler, Dufonr and von Seebach	13	$8\frac{1}{2}$	60	. .	13.3	16.4	. .	4,158	4,000
,,	Postelberg	Saatz	Prince Schwarzenberg	1	48	94	. .	6.6	20.2	. .	3,797	15,000
Coal	Kounowa, Rakonitz Trebotz, Dutschitz, and Kronczowa	Neustraschitz	,,	4	$1\frac{1}{4}$, $1\frac{3}{4}$, $1\frac{3}{4}$, $1\frac{1}{2}$	119	. .	10.85	12.9	. .	4,900	6,000
,,	Buschtiehrad	Unhoset	H.M. the Emperor Ferdinand I.	(3) (1)	18 to 36, 21	1,223	14	7.1	4.3	65.99	5,819	196,000
,,	Brandeisl	Schlau	Imp. Austrian State Railroad Company	1	15	360	3	5.7	9.5	. .	5,627	60,000
,,	Kladno	,,	,,	1	36	520	2	13.75	9.5	. .	5,356	96,000
,,	,,	,,	Prague Iron Company.									
,,	Rassitz	Unhoscht	,,									
,,	Jemnik	Schlau	Dr. E. Mitsch and J. Stüdl	1	3	60	1	. .	. .	. .	. .	7,300
,,	Rakonitz	. . . . . .	A. Schussansky	1 (5)	19.3	60	1					
,,	Wegwanow	Zbirow	The Crown	2	24	142	4	uppr 5.6, lwr 26.4	12.1, 9.0	. .	5,135, 3,853	10,800
,,	Stielitz	Horowitz	Elector of Hessia	2	3	. .	6 to 10	. .	. .	. .	. .	140
,,	Miröschau	Dobino (Rokitzan)	Fr. Jahnl	1	5 to 6	. .	80	2	. .	. .	. .	10,000
,,	Mantan	Chotieschan	A. v. Lindheim	5	23	100	2	13.0	3.92	65.5	5,576	
,,	Wranowa	Mies	A. Seifert	1	2	. .	. .	. .	. .	. .	. .	200
,,	Wilkischen	,,	Albrecht and Seifert	1	3 to 4	96	. .	5.72	11.07	53.37	5,548	1,400
,,	Nürschan	Staab	Dr. F. Pankraz	3	10 to 12	400	. .	13.568	4.4	5.35	5,780	1,100
,,	Schatzlar	. . . . . .	Baron Silberstein	3	21	250	. .	9.0	3.4	62.3	. .	22,000
,,	Schwadourtz, Nachod, and Trautenan	. . . . . .	Prince Schaumburg-Lippe No. 1 = $5\frac{1}{2}$ to 8 ft.; 2 = $2\frac{1}{2}$ to 3 ft.; 3 = $4\frac{1}{5}$ to 5 ft.; 4 = 2 to $2\frac{1}{4}$ ft.; 5 = 2 to $2\frac{1}{3}$ ft.; 6 = 4 ft.; 7 = $1\frac{1}{3}$ to 2 ft.; 8 = 2 to $5\frac{1}{2}$ ft.; 9 = 2 to $6\frac{1}{2}$ ft.; 10 = $3\frac{1}{2}$ to 4 ft.; 11 = 2 to	11	35.3 in. to 45.3 in.	400	3	10.56	2.16	58.90	5,890	40,000

Brown Coal		Gaya	Prince Krautheim	1	9 to 14	44	2	10.76	7.66	. .	2,892	76,000
,,	Zierawitz	Gaya	Baron Sina	1	42	66	1	11.1	19.0	. .	3,853	72,000
,,	Dubnian	Göding	R. Kolisch	1	8	60	. .	14.4 {	13.0 to 33.1 }	. .	2,554	39,000
,,	Boskowitz	Brünn	Count Mensdorff-Pouilly	1	4 to 6	40	. .	30.6	18.3	. .	2,825	22,000
,,	Trübau	,,	F. Steinbrecher	2	4 to 5½	32	. .	44.1	8.5	. .	2,723	18,000
Coal	Zbeschau	Eibenschütz	A. Rahn and Co.	2	10½ to 19	300	5	6.1	0.5	. .	6,735	48,000
,,	Padochau	,,	Klein Brothers	1	18 to 20	200	4	5.0	1.0	. .	6,348	17,000
,,	Polnisch-Ostrau	Oderberg	J. Zwierzina	1	12 to 14	350	5	3.1	1.6	63.6	6,316	73,200
,,	Mährisch- and Polnisch-Ostrau, Privos, Hruschau, and Mechalkowitz, Mährisch-Ostrau and Oderberg	. . . .	The Imperial North Railroad Company [Francisca, 5 to 6 ft.; Bruno, 2½ ft.; Flora, 3 ft.; Joseph, 9 ft.; No. 2=3½ ft.; No. 4=3 ft.]	6	27	1,641	24	6.5	1.2	70.3	6,344	108,800
,,	Polnisch- and Mährisch-Ostrau, Hruschau, Mährisch-Ostrau and Oderberg	. . . .	Baron Rothschild	26	83½	1,408	16	7.98	1.5	63.3	6,032	170,000
,,	Karwin	Freystadt	Count Larisch-Mönnich	4	16½	1,047	9	2.5	1.6	60.5	6,113	32,300
,,	Peterswald	Oderberg	,,	3	11¾	863	5	3.3	0.3	67.6	6,271	32,000
,,	Orlau-Laz	Freystadt	Count Fürstenberg	2	11½	90	4	1.8	1.4	66.3	6,158	11,000
			GALICIA.									
Brown Coal	Skwarzawa	Zolkien	F. Lang and Co.	1	. .	. .	. .	12.6	24.4	. .	3,094	
,,	Myszyn	Kolomea	J. Hecker	2	6 to 7½							
Coal	Jaworzno	Cracow	The Crown—(Frederic-Augustus mine, Jacek mine, Niedzieliska mine)	1 2 3	12 30 21	396	13	5.64	13.18	. .	4,781	42,000
,,	Siersza and Tenczynek, Jaworzno and Krzeszowice	Cracow	Count Potocki	3	23½	208	5	5.0	17 0	. .	4,913	14,000
			HUNGARY AND BANAT.									
Peat	Ungarisch-Altenburg	Weiselburg	The Archduke Albrecht	1 (Moor)	1⅘	50						
,,	Szent-György-dbrány, (Puszta Bánháza)	Szabolcs	A. Han	1 (Moor)	3							
Brown Coal	Dios Györ	Borsod	The Crown	1	4	30	. .	13.78	18.7	. .	3,604	700
,,	Bubendorff	Odenburg	H. Drasche	1	18 to 36	500	3	6.13	11.1	. .	4,282	14,700
,,	Sárisáp	Annathal	Count Sandor	3	35	140	1	7.26	13.05	. .	4,152	14,000
,,	Dorogh, Tokod, Miklosberg, Mogyros Gran.	. . . .	H. Drasche	. .	. .	. .	. .	7.02	8.5	. .	4,317	
Coal	Fünfkirchen	Baranya	L. Littke	2	. .	30	1	5.9	0.8	. .	6,898	3,300
,,	,,	,,	Imp. Danube Steam Nav. Company	25	140	800	6	13.4	1.5	82.0	6,147	140,000
,,	Szabolcs	,,	A. Riegel	. .	. .	. .	. .	6.6	1.3	80.7	6,384	
,,	Somogy	,,	H. Drasche									
,,	Vassas	,,	H. Thies	2	33	14	2	5.1	1.2	71.0	6,141	1,800
,,	Szász	,,	H. Drasche									
,,	Steyerdorf	Lugos (Banat)	Imp. Austrian State Railroad Company	3	14 to 19	631	6	1.74	2.14	66.18	6,451	72,000
,,	Domau, Montau, Reschitza, and Krassova	(Banat)	,,	2	10	202	1	1.7	8.2	79.4	7,229	1,400
,,	Szekul	Kuptore, Reschitza	,,	3	11	165	. .	0.95	4.9	65 0	5,983	10,000

Specimen Exhibited.	Place or Name of Mine.	District.	Owner.	No. of Seams.	Thickness. Feet.	People Employed.	Steam Engine.	Quality of Coal. Ash.	Water.	Coke.	Caloric Units.	Tons Raised.
Brown Coal	Petroseny, Dilsa, and Vaydi	(In the valley of the Schil river) Hunyad	The Mining and Smelting Joint Stock Company of Kronstadt	11	1 to 7	. .	. .	6.5	2.1	57.8	5,582	
MILITARY BORDER.												
Brown Coal	Sikewitza	Bersaszka	Fülepp and Fuchs	1	15	6	. .	2.35	17.4	. .	4,307	70
Coal	Drenkova	,,	C. Kleiu	2	. .	350	. .	9.38	0.6	62.0 and 77.0	5,638	9,000
			Kosla	. .	2 to 15							
			Kameritza	. .	2 to 6							
ESCLAVONIA.												
Brown Coal	Gradiste and Bogdau	Pozega	J. D. Popovic	2	22	30						
CROATIA.												
Brown Coal	Ivanec and Kulepcina	Warasdin	Zinc Mining Association	2	20 to 34	. .	1	8.6	18.0	. .	4,136	
,,	Bregana	Agram	A. v. Kiepach					1.5	15.0	. .	4,384	
,,	Vranovma and Ponikari	,,	Topusko Iron Works of Petrovagora	. .	. .	6	. .	9.08	21.9	. .	3,386	110
				1	5 to 16	10	. .	6.0	18.5	. .	5,034	400
AUSTRIA AND SALZBURG.												
Peat	Kirchberg am Walde	Schrems	Count Blacas d'Aulps	1 (Moor)	. .	4						
,,	Salzburg	,,	R. v. Mertens and Co.	1 (Moor)	. .	200						
Brown Coal	Zillingdorf	Wiener-Neustadt	H. Drasche	. .	. .	. .	. .	135	358	. .	2,486	
,,	Glossnitz	,,	,,	. .	. .	. .	. .	7.3	11.3	. .	4,102	
,,	Schleinz (Schauer-leiten)	Wiener-Neustadt	F. Güdl	2	6 to 11	76	1	. .	. .	. .	. .	2,700
,,	Thallern	Atzenbrugg	H. Drasche	. .	. .	. .	. .	11.6	16.0	. .	3,700	
,,	Griftnergut	Vöklabruck	Mayr and Baldinger	1	12 to 15	10	. .	3.7	31	. .	3,050	1,200
,,	Wolfsegg, Kaletsberg, Feitzing, Thomasroith, Schwanenstadt, Vöklabruck, Ried, Haag	. . . . .	Wolfsegg-Traunthal Coal and Railroad Company	. .	. .	800	. .	8.3	14.85	. .	3,640	96,000
,,	Grünbach	Neunkirchen	Reger and Schlick	1	6 to 7	150	1	5.0	4.4	. .	5,514	11,000
,,	Raitzenberg	,,	,,	1	3 to 3½	30	. .	3.6	5.0	. .	5,672	1,700
,,	Lanzing	,,	,,	1	3½	4	. .	7.1	5.6	. .	5,104	110
,,	Kulmer	,,	,,	1	1 to 2	4	. .	10.0	10.9	. .	4,316	90
Coal	Tradigist	Kirchberg an der Pielach	A. Fischer	2	2½ to 4	14	. .	16.43	1.26	64.7	5,476	800
,,	Schrambach	Lilienfeld	A. Osterlein	1	4	160	. .	25.4	0.7	. .	5,256	4,800
,,	Kleinzell	Hainfeld	Fray and Strauss	1	2½ to 4	20	. .	5.2	0.5	. .	5,763	110
,,	Gresten	Guming	A. Töpper	1	1 to 1½	25	. .	2.3	1.0	67.1	6,701	280
[illegible]	[illegible]	[illegible]	[illegible]	1	12	25		1.57	2.5	70.0	5,379	9,300

Brown Coal	Häring	Kufstein	The Crown	1	31	106	. .	3.2	7.7	. .	4,734	3,800
,,	Wirtatobel	Bregenz	C. Schwenger	1	3 to 5	. .	. .	10.7	10.6	. .	4,468	

STYRIA.

Brown Coal	Langenwang (Illach)	Mürzzuschlag	J. R. v. Wachtler	2	5 to 12	11	. .	4.6	21.5	. .	3,758	
,,	Rettenegg (Kogel)	Vorau	,,	3	54	9	. .	10.9	15.4	. .	3,093	280
,,	Winkl (Gamsgraben)	Bruck	,,	14	48 to 120	4	. .	16.9	. .	. .	4,107	
,,	Urgenthal	,,	The Crown	1	5 to 6	. .	. .	1.5	8.8	. .	5,198	8,800
,,	Seegraben	Leoben	H. Drasche	. .	. .	. .	. .	5.8	9.3	. .	4,771	
,,	Holzbrücke	Knittelfeld	Count Donnersmark	1	3 to 5	12	. .	32.0	11.7	. .	3,017	
,,	Sillweg	Judenburg	,,	1	6 to 7	62	. .	15.0	10.8	. .	4,291	
,,	Folnsdorf	,,	The Crown	1	4 to 24	385	2	4.9	8.4	. .	5,073	42,000
,,	Ilz	Fürstenfeld	Borkentein and Son	1	3 to 4	20	. .	. .	. .	. .	. .	1,700
,,	Köflach	Voitsberg	Pendl and Steer	1	36 to 78	50	. .	3.2	19.0	. .	3,807	13,500
,,	Lankowitz, Pichling	,,	Count Meran	1								
,,	Tregist	,,	G. Mayerhofer	1	72	. .	. .	. .	. .	. .	. .	
,,	Tregist and Oberdorf	,,	Sprung Brothers	1	36 to 60	20	. .	5.02	14.15	. .	3,864	2,200
,,	Graden	,,	R. von Horsteg	1	144	14	1	3.8	33.5	. .	3,229	2,200
,,	Schaflos	,,	Fr. Satter	1	96 to 132	20	. .	4.9	17.4	. .	3,695	700
,,	Schönegg / St. Ulrich	Eibiswald	Gratz and Laybach Sugar Refinery	2	6 to 18	30	. .	7.23	14.63	. .	4,124	3,900
,,	Steyeregg	,,	J. Griessler	1	6	36	. .	6.9	16.7	. .	4,156	6,600
,,	. .	,,	The Crown	1	2 to 21	116	. .	4.58	10.1	. .	4,956	12,000
,,	. .	,,	Kleindienst and Plenk	1	12	14	. .	0.8	11.4	. .	5,288	1700
,,	Sula	Windischgratz	Rosthorn and Dickmann	1	12	.	. .	3.0	10.1	. .	4,320	
,,	Buchberg	Cilli	F. Schuscha	1	18 to 24	32	. .	4.2	21.2	. .	4,152	3,400
,,	,,	,,	Pragwald Mill Association	1 (No. 3)	9 to 15	50	1	. .	. .	. .	. .	2,200
,,	Trifail	Tüffer	The Crown	1	120	114	. .	6.6	16.5	. .	4,057	6,500
,,	Reichenburg	. .	H. Drasche									
,,	Anthracite, Tarrach	Marau	Prince Schwarzenburg	1	30	. .	. .	27.6	1.5	. .	5,039	1,000

CARINTHIA.

Brown Coal	St. Stephan	Wolfsberg	Baron Herbert	1	9 to 15	10	. .	4.0	16.9	. .	3,684	670
,,	Oberloibach	Bleiburg	Countess Egger	1	14	412	. .	7.9	18.3	. .	3,751	650
,,	Wiesenau	St. Leonhard	Count Donnersmark	1	9 to 15	12	. .	18.1	21.3	. .	3,361	
,,	St. Egiden	Rosseck	Baron Herbert	1	30	6	. .	. .	. .	. .	. .	830
,,	Streitehen	Bleiburg	Count Valsassina									
,,	Liescha	Bleyburg	Rosthorn and Dickmann	1	34	600	3	6.5	21.2	. .	4,090	34,400

CARNIOLA.

Brown Coal	Laybach	A number of diggings on the great Laybach Moor of more than 66 English square miles		On the average 6 feet.								
,,	Loke	Littai	Arnsten and Eskeles	1	72 to 150	130	. .	2.1	17.0	. .	4,582	700
,,	Scheming	,,	Krantz and Co.	1	12 to 60	2	. .	3.8	19.8	. .	4,112	
,,	,,	,,	,,	1	30 to 60	2					. .	
,,	Dobletsche	Tschernembl	F. R. v. Fridau	4	15	16	. .	18.3	14.9	. .	3,829	5,000
,,	Johannesthal	Nassenfuss	L. Kuschel	1	18	8	. .	. .	. .	. .	. .	70
,,	Gotschee	. .	Raisinger Brothers	1	12	10	. .	. .	. .	. .	. .	1,600

DALMATIA.

Brown Coal	Siverich	Dernis	Macale and Galvani	1	48	80	. .	6.2	12.0	. .	4,339	6,500

PARTICULARS OF THE STRATA SUNK THROUGH AT HIGH PARK COLLIERY, IN PARISH OF GREATLEY, IN THE COUNTY OF NOTTINGHAM, ON THE ESTATE OF VISCOUNTESS PALMERSTON.

August 14, 1854. Set-out shafts 10 ft. diam. within brickwork.

No. of Str.	Thickness of Strata. yds.	ft.	in.	Name of Strata.
	2	0	0	Raised pit top.
1	0	2	5	Yellow clay.
2	1	0	9	Blue bind.
3	2	0	4	Ditto and ironstone. (First water.)
4	0	1	8	Black bind.
5	0	1	0	Dark clunch with ironstone.
6	0	0	10	Black shale. (Water.)
7	1	1	4	White clunch.
8	0	0	2	Coal. (Water.)
9	0	0	11	Dark clunch.
10	0	0	3	Coal. (Water.)
11	0	0	9	Dark clunch.
12	0	0	9	Blue bind.
13	0	0	5	Grey stone. (Water.)
14	0	0	7	Blue bind.
15	1	2	6	Grey stone. (Water.)
16	3	1	0	Blue bind.
17	0	1	1	Coal. (Water.)
18	0	2	0	Light clunch.
19	1	0	0	Light stone.
20	7	1	6	Dark blue bind.
21	0	0	10	Black shale. (Water.)
22	0	2	0	Coal.
23	3	0	0	Dark clunch.
24	1	0	0	Blue bind.
25	0	2	4	Coal and Smut.
26	1	2	6	Light clunch. Nov. 2, 1854, wedging and tubbing corb. wood 16 × 10 in., stopped back water.
27	1	2	6	Clunch and ironstone.
28	8	0	2	Dark blue stone bind and ironstone.
29	2	1	0	Ditto bind with light stone beds.
30	6	1	0	Grey stone with smut beds. (Much water.)

Jan. 26, 1855. Commenced working the first lift of 9 in. pumps.

No. of Str.	yds.	ft.	in.	Name of Strata.
31	0	2	0	Dark stony bind.
32	3	1	5	White stone mixed with bind. 2nd tubbing corb.
	1	0	10	White stone. (Much water, 1000 gallons per minute.)

Oct. 3, 1855. Commenced working with two sets of 9 in pumps.

May 19, 1856. Commenced pumping with four sets of 9 in pumps.

Sept. 6, 1856. Stopped pumping; could not lower the water in either shaft.

Nov. 22, 1858. Commenced pumping with four sets of 9 in. pumps.

Jan. 27, 1859. Commenced cleaning dirt out of pit bottom.

No. of Str.	Thickness of Strata. yds.	ft.	in.	Name of Strata.
33	0	0	3	Dark clunch.
34	0	0	4	Black shale.
35	0	0	10	Coal.
36	0	0	3	Soft sloome.
37	1	0	3	Clunch.
38	2	0	6	Grey stone. (Water, 300 gallons per minute.)
39	0	0	11	Stone bind. 3rd tubb. corb.
40	1	2	1	Stony bind. 4th ditto.
,,	0	1	0	Ditto.
41	1	2	0	White stone. (Water, 80 gallons per minute.)
42	0	0	3	Ironstone.
43	1	0	8	Dark bind.
44	0	0	1½	Ironstone.
45	1	0	0	Dark bind.
46	0	0	1½	Ironstone.
47	0	1	11	Dark bind.
48	0	0	1½	Ironstone.
49	0	2	7	Dark bind.
50	0	0	1½	Ironstone.
51	0	2	11	Very dark bind.
52	0	2	11	Coal. (Water, 35 galls. min.)
53	1	2	6	Dark clunch. 5th tub. corb.
,,	2	2	10	Very dark bind.
54	0	2	3	Strong coal.
55	0	1	4	Light clunch.
56	0	1	8	Dark bind.
57	0	1	3	Light bind.
58	0	0	5	Coal and bat.
59	0	1	9	Clunch.
60	1	2	6	Grey stone. (Water, 130 gallons per minute.)
61	0	1	0	Stony bind. 6th tubb. corb.
,,	0	0	7	Stony bind.
62	0	1	10	White stone (Water, 110
63	3	1	6	Ribbony stone galls. min.)
64	1	0	4	Strong blue bind.
65	0	0	2	Ironstone.
66	0	1	6	Strong blue bind. 7th tubb. corb., 29th Dec., 1859.

PARTICULARS OF STRATA AT HIGH PARK COLLIERY—*continued.*

No. of Str.	Thickness of Strata. yds.	ft.	in.	Name of Strata.
66	2	0	10	Blue bind with ironstone balls.
67	1	0	0	Soft coal.
68	1	0	6	Light clunch.
69	1	2	4	Blue bind.
70	0	1	2	Coal and bat.
71	1	2	6	Light clunch.
72	2	0	1	Dark stone.
73	0	0	9	Light stone.
74	1	0	5	Strong bind. 8th tub. corb.
,,	0	2	6	Raised pit top. Mar. 1860.
75	3	1	0	Blue bind and ironstone. 9th tubbing corb.
76	5	0	6	Strong bind and ironstone. 1st bricking corb.
77	0	2	0	Black shale.
78	0	0	2½	Ironstone.
79	0	0	8	Black shale.
80	0	0	2½	Ironstone.
81	0	2	9	Dark bind.
82	0	0	10	Black shale.
83	0	1	8	Coal.
84	1	0	7	Strong stone clunch.
85	0	0	6	White stone.
86	7	1	0	Dark bind and ironstone. 2nd bricking corb.
,,	0	1	8	Dark bind and ironstone.
87	0	2	6	Black shale.
88	0	2	4	Coal.
89	0	1	2	Bat.
90	2	1	8	Strong clunch.
91	0	0	2	Bat.
92	0	1	1	Clunch.
93	0	0	3	Bat.
94	1	1	4	Stone clunch. 10th tubb. corb.
,,	0	2	1	Stone clunch. Jul. 6, 1860.
95	6	2	10	Stony bind.
96	0	0	7	Black shale.
97	1	0	6	Stone clunch.
98	2	0	5	Stony bind.
99	0	0	6	Bat.
100	0	1	8	Clunch.
101	0	1	7	Bat and coal.
102	0	2	8	Clunch. 3rd bricking corb. July 31st, 1860.
103	1	0	8	Stone clunch.
104	2	1	0	Stony bind.
105	0	0	10	Coal.
106	1	0	10	Light clunch.
107	0	1	7	Cank.

No. of Str.	Thickness of Strata. yds.	ft.	in.	Name of Strata.
108	2	2	0	Grey stone.
109	1	0	9	Stony bind. 4th bricking corb.
,,	4	2	4	Stony bind.
110	0	1	0	Black shale.
111	1	2	4	Light clunch.
112	3	0	6	Grey stone.
113	1	0	4	Stony bind. 5th bricking corb, Aug. 22, 1860.
,,	2	0	9	Stony bind.
114	1	0	2	Dark stony bind.
115	0	2	3	Black shale with thin beds of ironstone.
116	0	1	9	Dark stone clunch.
117	0	1	8	Cank. Aug. 28th, 1860.
118	1	2	9	Stone.
119	2	1	4	Dark bind. 6th bricking corb., Sept. 3, 1860.
120	8	0	2	Stony bind. 7th bricking corb., Sept. 13, 1860.
121	0	1	9	Coal.
122	0	1	0	Dark stone clunch.
123	2	1	6	Grey clunch.
124	0	1	8	Black shale. 8th bricking corb., Sept. 22, 1860.
,,	0	1	0	Black shale.
125	0	2	8	Blue bind.
126	0	0	4	Cank.
127	2	1	8	Black shale.
128	4	1	6	Bind and ironstone. 9th bricking corb.
129	0	2	6	Soft coal (Comb coal). Oct. 1, 1860.
130	2	1	0	Clunch and ironstone balls.
131	0	1	1	Soft roof } Top hard or Rifler coal. 5 ft. 1 in
	0	0	10	Rifler }
	0	1	10	Main hard }
	0	1	4	Bottom soft }
132	0	0	6	Holing sloome.
133	0	2	1	Clunch.
134	1	2	2	Stone.
135	2	2	11	Blue bind.
136	0	1	1	Coal.
137	1	1	6	Clunch. 10th brick. corb.
138	4	1	0	Stone bind.
139	0	0	3	Ironstone.
140	4	1	9	Blue bind and ironstone. 11th bricking corb. Bottom of sump.
141	0	2	1	Dunsil coal.

PARTICULARS OF THE STRATA SUNK THROUGH AT COTMANHAY COLLIERY, IN THE PARISH OF ILKESTON, IN THE COUNTY OF DERBY.

No. of Str.	Thickness of Strata.			Name of Strata.
	yds.	ft.	in.	
1	2	0	0	Soil and clay.
2	0	2	6	Coal.
3	1	0	6	Soft clunch.
4	0	2	6	Brown stone. (Water in these measures: Nos. 4–29)
5	2	1	0	Soft bind.
6	0	0	3	Ironstone.
7	2	1	0	Stone bind.
8	0	1	1	Grey stone.
9	0	1	8	Stone bind.
10	7	1	8	Soft soapy bind.
11	1	0	6	Soft bind with black bands of thin ironstone.
12	0	2	6	Black shale.
13	1	0	7	Soft white bind.
14	0	1	8	Jay and coal.
15	1	1	8	Dark clunch.
16	0	1	1	Stone.
17	2	1	0	Stone bind with ironstone beds.
18	0	0	3½	Ironstone. (Whetstone rake.)
19	7	2	0	Broad bind with ironstone beds.
20	1	0	4	Black bind.
21	0	0	3	Ironstone.
22	12	0	0	Broad black bind.
23	1	2	6	Soft white bind.
24	1	0	2	Black shale.
25	0	2	9	White bind.
26	0	0	4	Ironstone } Brown rake.
27	1	0	2	Black shale } Brown rake.
28	0	0	4	Ironstone } Brown rake.
29	0	1	6	Bind and shale alternately.
30	0	1	2	Coal
31	0	1	6	Fire clay.
32	1	1	0	Strong stone clunch. Tubbing corb.
33	3	1	0	Strong bind with ironstone.
34	0	1	0	Craw stone.
35	0	0	6½	Ironstone.
36	0	2	0	Black shale with large balls of ironstone } Black rake.
37	0	0	4	Stone (bottom ironstone). } Black rake.
38	0	2	2	Black shale.
39	0	1	6	Clunch.
40	1	2	0	Stone bind with ironstone.
41	0	1	2	Coal (Ell).
42	0	2	6	Strong stone clunch.
43	3	0	6	Stone.
44	0	1	0	Clunch.
45	0	1	4	Coal.
46	2	0	0	Stone clunch.
47	5	0	0	Stone and Cank.
48	4	0	0	Strong stone bind.
49	0	2	6	Main smut.
50	0	0	6	Soft clunch.
51	1	2	8	Stone.
52	3	2	6	Strong broad bind.
53	1	0	2	Main soft coal.
54	0	0	4	Bat.
55	2	0	0	Stony clunch.
56	1	0	0	Dark stone.
57	11	0	0	Strong broad bind with small beds of ironstone.
58	1	0	4	Hard Pothouse coal (main).

BRITISH ASSOCIATION MEETING AT CAMBRIDGE.

ON BITUMINOUS SCHISTS* AND THEIR RELATION TO COAL.

By Professor D. T. Ansted, M.A., F.R.S.

Rocks in which naphtha, petroleum, rock oil, bitumen, asphalte, and other mineral hydrocarbons are present in sufficient abundance to cha-

* This term, "bituminous schists," is not altogether correct, as the minerals so called do not contain bitumen properly so called. It is, however, in familiar use, and to be preferred to the term "pyro-schist" suggested by Dr. Sterry Hunt, which is equally incorrect, without having the advantage of being familiar.

racterize the deposit or attract attention, are widely distributed in various geological formations, and belong to no special geological period. Crystalline and metamorphic rocks contain chapopote and other forms of bitumen. Rock oil rises in jets from below Silurian, Devonian, and carboniferous rocks in North America. Bituminous limestones and schists occur in Ireland in Silurian rocks, and at Caithness in Devonian rocks, and elsewhere, not unfrequently in the British Islands, in carboniferous rocks. Bituminous schists are important in the Permian series in Germany, and not absent in the New Red Sandstone. The Posidonia schists of the Lias and other beds are highly bituminous, and in the Oolites, the cretaceous rocks, and even in the Tertiaries, especially in Germany, the same bituminous character often prevails. Asphalte is common in some Tertiaries; oil rises from the nummulitic rocks in the East, and in the West Indies we have the Pitch-lake of Trinidad.

In almost all these cases there is a marked distinction between coal, properly so called, and rocks containing the hydrocarbons. Coal is mineral fuel, from which gas can be obtained by destructive, and occasionally certain oils by slow, distillation. The various bituminous rocks or bitumens contained in rocks are not good fuel, but yield largely certain valuable products by slow distillation. Coal can be coked, and the coke, or unburnt carbon, is a valuable fuel. The best and richest of the bituminous schists will not coke, and the result of an attempt to make it is to produce an ash that will not burn.

Notwithstanding this general distinction, coal passes insensibly into cannel coal, or parrot, and this again appears to pass into those peculiar shales rich in bitumen, known in Scotland as Boghead coal or Torbane Hill mineral. These remain debatable ground. Specimens of them, carelessly collected, have been used as fuel; but parts of the same sample are often coal, while the rest is shale, and thus much confusion has arisen as to the fuel question. They are unusually rich in valuable oils, and form a curious passage between two minerals—coal and shale, or schist—that do not generally bear any resemblance.

The distinction between coal and shale is practically very important, and deserves careful consideration. I wish to direct the attention of the Section to some instances that may help to throw light upon the question.

Two localities in France visited by me in the year 1861 are particularly interesting in this respect, and deserve to be better known by English geologists than they seem to be. The rocks in both are of the carboniferous period. The various places where the Lias schists are now worked for distillation, chiefly in Germany, are also worthy of special reference, and the Tertiary bituminous shales of the Rhine are not less important.

At Feymoreau, a short distance from Fontenay-le-Comte, situated in the Bourbon Vendée, between Nantes and Rochelle, there is a small coal-field, almost classical in respect to the important distillation of light oils by slow distillation of rocks containing hydrocarbons. It was at this spot, then far less accessible than it now is, that M. Selligué, so long ago as in 1830, obtained light paraffine oil, heavier illuminating oil, lubricating oil, and paraffine, by a method identical with that patented by Mr. Young in England in 1851. The works were abandoned owing to the want cf communication with a market, and M. Selligué afterwards established works, still carried on successfully, at Autun.

The Feymoreau schists underlie coal of a poor quality, and thus replace underclay, but they contain no vegetable impressions or markings. They are of deep black colour, hard and tough when first exposed, but fall to pieces after a time. They burn freely, with much smoke and a long flame, but cannot be used as fuel. Externally they much resemble the better qualities of Boghead and Torbane Hill mineral, but they yield only about 15 per cent. of light oil on slow distillation. They contain 60 per cent. of ash, and some water. The schists and coal both vary in thickness, and occasionally seem to pass into each other. The schists are in some places 30 to 40 feet thick, but they do not extend far in any direction, or at least if they extend under the coal, which seems probable, they are not everywhere bituminous.

The Feymoreau schists agree with the rich hydrocarbon minerals of Torbane Hill and Boghead, in Scotland, in appearance, geological position, and in the fact that they occasionally alternate with coal. They differ in being far less rich in useful products, and they are always and readily distinguishable as schists, never putting on the appearance of true coal.

On the other side of France is Autun, where there is also a small coal-field; but where bituminous schists of precisely the same nature as those at Feymoreau generally occur in a part of the carboniferous series considerably above the highest coal-seam, and several hundred yards above any workable bed. Below the coal at Autun are coarse grits of granite and gneiss, alternating with black shales.

The bituminous shales are partly quarried, and partly obtained by drifts or headings reaching the more valuable beds. There are about ten feet of bituminous schist at Cordesse, where I visited the operations of mining and manufacture; and of these five only are valuable. Elsewhere the thickness is greater. The broken schist is black; but at the surface, while in the bed, it is reddish-brown. The percentage of bitumen is very variable, sometimes amounting to 50 per cent. of oils of all kinds, but the average not much exceeding 6 at Cordesse, though much higher at Igornay, a place in the neighbourhood where there are also works. At Chamboy, the rich shales are nearer the coal and alternate with it. A grey limestone and grey ironstone occur in some parts of the Autun coal-field.

The Autun mineral oils are moderately rich in paraffine. The shales will not serve as a fuel, and are never so employed. Some beds are rather pyritous, and others abound with vegetable impressions, differing in this respect from the Feymoreau schist. The general resemblance of the Autun specimens to Boghead is very striking.

The manufacture of schist oils and paraffine candles is carried on extensively in more than one place near Autun, and the quantity supplied is large. The methods adopted are the same as those of Mr. Young in general principle, and are said to have been little altered for twenty years.

The Tertiary shales below the brown coal on the Rhine are found in many places to be very bituminous. They have no resemblance to coal or brown coal, and are easily distinguished from the latter. They are thin, and form the *blätte*, or *paper coal*, of the Germans. They are worked near Linz and elsewhere, and are distilled at Beul, opposite Bonn, the products being precisely similar to those obtained from the other bituminous schists, and in nearly the same proportions; but the yield is small.

The Posidonia schists of the Upper Lias are worked at present for economic purposes at Bamberg, in the north of Bavaria, and at Reutlingen, near Tübingen, in Würtemberg. The manufacture of light paraffine oil, heavy oils for burning, lubricating oil, and paraffine, has been carried on with some success by the distillation of these schists for some years. Recently a similar establishment has commenced work with the schists of similar age at Orawicza in Hungary, near the Danube at Baziasch.

The Eisleben shales, amongst which the copper slate is deposited, are not less remarkable for their bitumen. This is apparently very intimately connected with the schists, well known to geologists for the abundance of fossil fish found in them. In this case, therefore, there seems great probability of the bitumen being of animal origin. No difference has been observed as to the contents obtained on distillation.

The Kimmeridge "coal" is an unmistakable shale, but some portions resemble lignite. It has occasionally been used for obtaining paraffine; but, being much less rich than the Scotch shales, the result is not sufficiently encouraging to justify a continuance of the experiment.

It is possible that some of the other black shales known in various deposits may be found available, and may come into use for distillation.

It is evident that bituminous schists of various dates, some associated with and resembling coal, some even passing into coal, others totally unlike coal in every respect and far removed from it geologically, exist in various countries in considerable abundance, and admit of profitable distillation at low heat for the purpose of manufacturing, illuminating, and lubricating oils and paraffine. It is important that such substances should be recognized as a class and not mixed up with coal, and that there should be some understanding as to what coal is, and in what it differs from the carbonaceous and bituminous minerals with which it is often loaded.

I append a list of a few of the rocks and localities where bituminous schists and their products are obtained. It would certainly admit of great expansion:—

Lower Silurian .	Ireland and America (Utica Slates).
Upper Silurian .	Ditto.
Devonian . . .	Caithness schists. Shale with 30 per cent. of organic matter, and a residue of 8 per cent. of carbon.
	American rock oils (some localities).
Carboniferous.	American rock oils.
	Torbane Hill and Boghead, etc., minerals.
Lower, Middle,	Parrots and cannel coal.
and Upper .	Terre houille of Belgium.
	Vauvont or Feymoreau schists, La Vendée.
Above coal .	Autun schists.
Permian . . .	Eisleben shales and Kupfer schiefer. 5 to 20 per cent. of light oils.
	Mansfeld schists.
Lias	Posidonia schists, worked in Northern Bavaria, at Banz; in Würtemberg, near Tübingen; at Oravieza in Hungary.
Oolites	Kimmeridge shale (Dorsetshire), a shale used for distillation to obtain paraffine, and occasionally serving as a very poor fuel.
Cretaceous . . .	Various schists in the Alps.
Tertiary . . .	Paper "coal," near Bonn (under the brown coal).
	Deposits beneath nummulitic rock in the East.

I have no doubt that a little research would remind us of many other localities, but these are enough to show the presence of a certain quantity of hydrocarbons (the result, there can be no doubt, of organic matter) exhibited in this form, a part of which has sometimes been converted into coal, but which is more usually quite distinct from coal and unconnected with it.

I have not alluded in this paper to the surface accumulations of petroleum or to the asphalte with sand and in sandstone, nor to the chapapote of Cuba—a very remarkable deposit, deserving distinct notice. I have confined my remarks to the bituminous schists, to bring the subject within compass.

ON THE SKIDDAW SLATE VEINS.

By Professor Harkness, F.R.S., F.G.S.

The author pointed out the several areas where the Skiddaw slates occur in Cumberland and Westmoreland. He then proceeded to detail the nature of a section from Newlands, between Derwentwater and Buttermere on the south, to the carboniferous rocks at Sunderland on the north. This section exhibits two well-marked axes; and through the series of rocks which occur between these axes and the green rocks appertaining to a higher series, wherever the Skiddaw slates put on a flaggy character, these strata afford fossils.

A section from the green rocks on the north of Great Dod, across Saddleback, the valley of the Calden, and Caldbeck Fells, through the Skiddaw slate beds, was next described. This section shows a considerable development of metamorphic rocks in the valley of the Calden in connection with the granite of Skiddaw Forest, as alluded to by Professor Sedgwick; and the strata in this section have for the most part a S.S.E. inclination. In this section, where the rocks are not metamorphical, and when devoid of cleavage, they also afford fossils.

A section along the eastern margin of the Skiddaw slate and the superficial green rocks of Westmoreland was next referred to. In this section three small but separate patches of Skiddaw slates were pointed out, viz. one on the S.E. side of Ullswater, another in Rosgill Beck, and a third in Thornship Beck; and in the two latter Skiddaw slate has been worked for slate-pencils. These also have furnished Professor Harkness with fossils, and their appearance is the result of three axes occurring between Ullswater and Wastdale Crag.

In a fourth section across Black Comb, the arrangement of the Skiddaw slates, as these occur in their most southern position in the Lake district, was also indicated. In the Black Comb area the prevalent dips are N.N.W., and from near the base of the Skiddaw in this section fossils were also obtained.

The organic remains which Professor Harkness procured from the several areas of Skiddaw slate consist for the most part of graptolites. Of these, there are two genera which have been recognized by Mr. Salter as known in the Quebec beds of Sir W. Logan and in the Lower Silurians of Australia, viz. *Tetragrapsus* and *Dendrograpsus* of Hall. Besides these there is a phyllopod Crustacean, which Mr. Salter regards as identical with a form from the Australian Lower Silurians. Professor Harkness also indicated the occurrence of tracks in the Skiddaw slates, and pointed out certain bodies which he regarded as the cases of Annelids allied to the modern Terebella.

The position of the Skiddaw slates and their fossil contents justify the conclusion that they are referable to the horizon of the Lower Llandeilo.

ON THE PALÆONTOLOGY OF MINERAL VEINS, AND THE SECONDARY AGE OF SOME MINERAL VEINS IN CARBONIFEROUS LIMESTONE.

By Charles Moore, F.G.S.

In directing the attention of the Geological Section of the British Association to the above subject, the author first referred to remarkable geological phenomena he had noticed in the Carboniferous Limestones of the Mendip Hills. Through the whole of this district he observed that the beds had been very much fissured, and that most of them had subsequently been filled in with deposits containing numerous organic remains of different geological ages, some of which were probably as young as the Inferior Oolite. A small roadside section at Holwell, on the south-east of the Mendip, was described, in which, at the base, Carboniferous Limestone was present; whilst resting unconformably upon it was a dense unstratified conglomeratic deposit, containing shells of the age of the Middle Lias, and on this rested thin horizontal beds of Inferior Oolite. The outcrop of a mineral vein was also present in this section. Near the above was a quarry 200 feet in length, within which were thirteen vertical fissures passing down through inclined stratified beds of Carboniferous Limestone: one of them being fifteen feet in breadth at the base of the quarry. These fissures, which occupied nearly one-third of the section, had been filled in by a dense variegated limestone, containing occasionally Brachiopoda, Crustacea, Belemnites, and fish and reptilian remains of secondary age.

In an adjoining quarry to the above Mr. Moore found a softer infilling, three cart-loads of which he removed to his residence, and found therein teeth of the *Microlestes*, the oldest known quadruped; various reptilia, including *Placodus* and *Thecodontosaurus;* more than 50,000 teeth of the *Lophodus*, together with an immense number of other organic remains, from the age of the Carboniferous Limestone to that of the Inferior Oolite, though they appeared chiefly to have been derived from the bone-bed of Rhœtic age.

In the upper portions of some of these fissures, galena, sulphate of barytes, and iron ore were occasionally present, which showed that in these cases the minerals must necessarily be of secondary age. Desirous of more fully investigating this point, the author examined the mineral deposits of the Mendips, in doing which he descended the Charter House Mine, and obtained very interesting results. The lead mines of this district had been extensively worked in the Roman period, the slags and slimes they left being now profitably re-worked. The vein-stuff of the above mine was found to be very varied in its character. At one point it was almost entirely composed of disjointed encrinital stems, with a few corals, all much abraded by the action of water. At a depth of 175 feet, where the working had ceased, there occurred a deposit of blue marl eight feet in thickness, which yielded $7\frac{1}{2}$ per cent. of lead ore. In this marl he found organic remains in the greatest abundance, and eventually succeeded in obtaining about 130 species, a few being derived from the Carboniferous Limestone, though the greater number were of secondary age. They consisted of an Ammonite, Belemnites, ten species of Brachiopoda, including Zellania—hitherto found only by the author in the Upper Lias and the Inferior Oolite; also, Thecideum, Crania, Lingula, Rhynchonella, Spirifer, etc. Of univalves, there were about thirty species; of Foraminifera, fifteen; fish remains were abundant, consisting of teeth, scales, and bones of probably fifteen species. In this clay were also blocks of stone containing shells and pieces of drift-wood, the latter having been converted into jet.

From these facts it became evident that the Mendip lead-veins had been within the influence of the ocean during the secondary period, and that the minerals they contained could not be of more ancient date.

The district around Bristol was then noticed, and it was shown that precisely similar phenomena occurred there in the Carboniferous Limestone. At Clifton, the Thecodontosaurus had been found; and it was urged that as he had found similar reptilian remains in fissures at Holwell, the deposits had been formed under corresponding circumstances. At Weston-super-Mare, also, numerous remains had been found in a fissure which was being worked for lead ore.

Perceiving that a general law prevailed in all the mineral deposits of the Carboniferous Limestone, the author next obtained samples from six mines in the same formation, from Shropshire, Yorkshire, and Cumberland; and in four of them found organic remains more or less abundant.

From Weardale, out of twenty-seven small samples they were obtained in fourteen—the lowest being 678 feet from the surface; they consisted of Cephalopoda, Brachiopoda, univalves, Foraminifera, Echini, Encrinites, Entomostraca, etc. From Alston Moor similar remains were obtained from five out of eleven samples; and from the White Mines, Cumberland, in two out of seven. The most interesting results obtained from vein stuff from the north of England, were from samples for which the author was indebted to Mr. Eddey, of the Grassington Mines, Shipton. In one small sample, which, when washed, was reduced to half an ounce in weight, not less than 156 specimens were found, including the little brachiopod *Zellania*, before mentioned as occurring in the Mendip vein, though never found in any stratified bed lower than the Upper Lias. Also, numerous univalves and Entomostraca, and a few minute claw-like bones or spines, similar to some he had found in one of the veins at Clifton. From this sample many *Conodonts* were obtained. These were supposed to be portions of crustacea, but they had hitherto never been found in strata higher than the Ludlow bone-bed of Silurian age.

Owing to the highly mineralized character of the vein stuff from the Conolly Mines, no organisms were observed, nor were any found in that from Twaledale. From the carbonaceous-looking character of the material in the latter case, the author suspected it to have been chiefly derived from the coal-measures.

Samples from a mine in Devonian, and also in Silurian strata, had been examined; but, owing to their mineralized condition, they yielded no organisms.

Mr. Moore argued that all our mineral veins, from the oldest to the more recent, were due to the same general laws; that there was no evidence of their contents having been derived from volcanic agency, nor, as has also been supposed, by any electrical action removing them from the adjoining rocks, and redepositing them in the veins. His view was, that the fissures now containing mineral veins, when open, had, during different geological periods, been traversed by the ancient seas of that time, and their derived contents deposited; and that whilst these infillings were proceeding, the minerals, which might previously have been held in solution in the water, were, by the operation of electrical or other causes, precipitated; and that thus, instead of being due to volcanic action, they were to be attributed to aqueous and sedimentary deposition.

ON THE GEOLOGY OF PART OF THE COUNTY SLIGO.

By Mr. A. B. Wynne.

In this paper the author stated that he had put together a few notes upon a very extensive district, which were made during a short trip in the summer of 1862. He alluded to the papers by Sir R. Griffith, Bart., Archdeacon Verschoyle, and Mr. John Kelly, upon parts of the same country, and proceeded to describe the district as composed of a great nearly horizontal series of stratified rocks, consisting of sandstones below, carboniferous limestones of impure, thin, and shaly character above, and paler, more pure limestones of the same group overlying them; the whole surmounted by 400 feet of the millstone-grit series. This group of horizontal rocks forms fine tabular mountains, with picturesque valleys, and a peculiar likeness in all their profiles. Cutting across the country formed by these horizontal beds is the rugged chain of the Ox Mountains, extending from Mayo across the county of Sligo to the south of Lough Gill, and terminating beyond Benbo mountain, in county Leitrim. Some of the most picturesque valleys in the county are the lateral ones near this chain, running along its flanks, and dividing the old micaceous and gneissose rocks of which it is formed from the horizontal series above alluded to; and in these valleys, as well as transversely crossing the chain, occur deposits of serpentine of considerable size and interesting character.

The denudation which exposed the Ox Mountains at the east end of the chain was alluded to, and the circumstance stated, that the limestone contained bands of sandstone which appeared to be of irregular thickness, and were most numerous in the lower part of the carboniferous series seen in the district under consideration.

The occurrence of trap-dykes and mineral deposits was noticed, and also the changes of level at recent periods, as well as the manner of the occurrence of the drift, which was found, in one instance, to contain shells of the common mussel, at a considerable distance from the sea, and in connection with which, the horns, skulls, and other bones of fossil deer and cattle had been found. The paper was illustrated, and a list of fossils (by W. H. Baily, Esq.) found in the district was appended.

ON THE CAUSE OF THE DIFFERENCE IN THE STATE OF PRESERVATION OF DIFFERENT KINDS OF FOSSIL SHELLS.

By H. C. Sorby, F.R.S.

Most geologists have, no doubt, remarked, that in very many rocks certain kinds of fossil shells are well preserved, whilst others are very badly preserved, or have entirely vanished, and left nothing but casts: for instance, oysters retaining their organic structure, whilst many others, like trigoniæ or most univalves, having lost their original structure, being quite crystalline, or even having been entirely removed. After having made many experiments with recent and fossil shells, the author has been led to conclude that this difference was due to the original difference in the mineral constitution of the various shells; and that when their carbonate of lime was in the state of *calcite* they were less prone to undergo any change; but where it was in the state of *aragonite* they always have had a tendency to become crystalline, by passing into calcite, or to be entirely removed if the conditions were more favourable to the crystallization of calcite in some other place rather than *in situ*.

NOTES AND QUERIES.

The Kyson Monkey.—A letter "On the Hyracotherian character of the Lower Molars of the supposed *Macacus* from the Eocene Sand of Kyson, Suffolk," by Professor Owen, F.R.S., has been published in the 'Annals and Mag. Nat. Hist.' (vol. x. p. 240). Professor Owen says, "The fossil teeth from the Eocene Sand at Kyson, in Suffolk, referred by me to a species of *Macacus*, are most probably the lower molars of a species of *Hyracotherium* (*H. cuniculus*). The great difference of shape between the upper and lower molars of *Pliolophus*, and the pattern on which the lower molars are differentiated in that Hyracotherioid animal, led me to suspect that the degree of difference between the upper molars of *Pliolophus* and those of *Hyracotherium* might be attended with a corresponding degree of difference in the lower molars of the two genera; and that such degree might render the lower molars of *Hyracotherium* as much like the lower molars of *Macacus* as the detached two molars are which were first discovered by Mr. Colchester, and described by me. In the collection of the late Mr. Acton were a series of both upper and lower molars from the Kyson deposits; the upper ones of the *Hyracotherium* type, and the lower ones analogous in their modifications to those in *Pliolophus*, but more resembling the type of *Macacus*, and the same in character as the original molars, which I referred in the volume of the 'Annals' above cited to *Macacus*."

Human Skeleton at Kellet, in Lancashire.—In the 'Geologist' for June, I contributed a brief notice of the above discovery of a human skeleton under the conditions detailed in the annexed excerpt from the 'Lancaster Guardian' of May 17th, 1862:—

"*Discovery of a Skeleton at Kellet.*—In the course of the present week the skeleton of a young woman has been found at Kellet, under the following circumstances:—On Wednesday, Mr. Bailie, of Lancaster, coal-merchant, was looking for rockery-stone amongst the limestone-rock at Kellet Seeds, and picked up in a natural fissure of the rock a bone, which he at once concluded to be that of the leg of a human being. On removing some other stones in the fissure, a perfect skeleton was found, lying on its side, with the skull underneath, and presenting the appearance of having been jammed in with some force. There was no sign of any metal, clothing, or hair, and as there was another fissure under the one in which the skeleton was placed, it is possible that any articles which might have aided identification have fallen into the cavity below. From the conformation of the skeleton it was evidently that of a woman, and the state of the teeth as clearly showed the youth of the individual. There can be little doubt that this is a revelation of some deed of violence. The district of Kellet, in days gone by, was rather noted for the lawlessness of its inhabitants, which had become proverbial. It is said in the village that about a hundred years ago a young woman left her home with some show-folks, and was not heard of again. This is the only fact we can glean as at all likely to elucidate the discovery at Kellet Seeds."

Through the kindness of Captain Barrie, R.N., and of W. Bollaert, Esq., F.R.G.S., I have had the opportunity of inspecting the fractured skull. The calvarium is large, full, and is markedly brachycephalic. The frontal sinuses are large, the supraorbital ridges being undeveloped.

Under the circumstances, as no implements, etc., were found with the skull, any generalization on its age would be premature. The limestone fissure being open at the top is a circumstance which throws great doubt

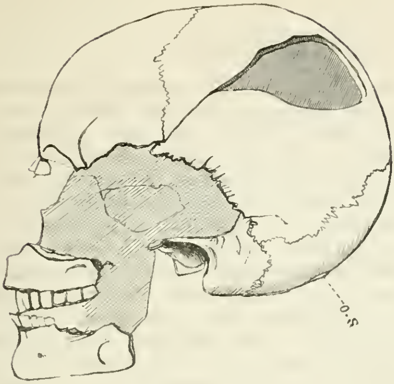
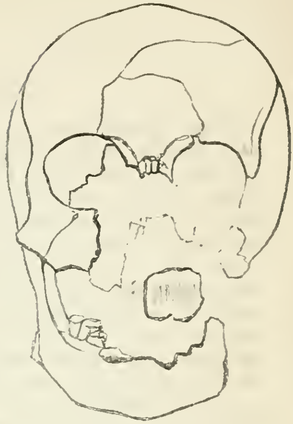


Fig. 1.



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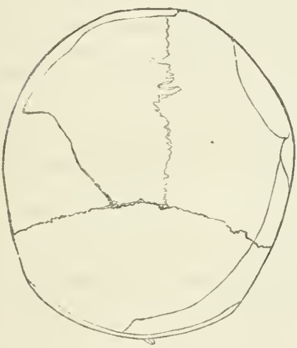


Fig. 3.

Fig. 4.

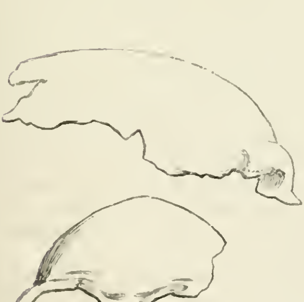


Fig. 5.

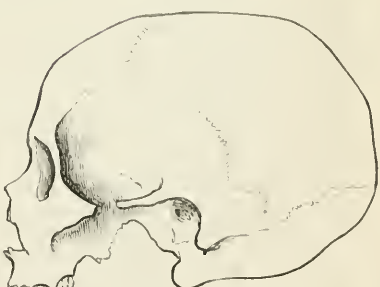


Fig. 6.

1-4. Kellet Skull. 5. Frontal Bone from Heathery Burn Cave. 6. Leicester Skull.

on the discovery. It is, however, possible that it may be at least as ancient as some of the other crania, *e.g.* the one from Mewslade, to which I have already referred.

I have Professor Busk's permission to subjoin the following extract of his notes on the Kellet skull:—

6th August.—"If the fissure in question were open from the top, it may be asked, why did not the body fall, or be introduced into it that way? Except from concomitant circumstances, and, in some cases, perhaps their chemical condition, I do not think much can be predicated of a single skull, at any rate with respect to its age, from its form alone. The Mewslade skull, also found in a limestone fissure, but with many very ancient animal remains, undoubtedly its contemporaries, is not, as you are aware, of the rounded type, like the Scandinavian and Scottish stone-age crania, but moderately dolichocephalic, and flat, or rather straight, along the summit. I have not seen the Etruscan skull you mention, but presume it to be, as you hint, brachycephalic. If so, the Kellet skull will not resemble the Mewslade and several of the river-bed skulls, which, there is reason to believe, are properly of a later population than the brachycephalic."

12th August.—"It is rather a curious form, being, as you say, strongly brachycephalic (about 850), and so far it corresponds with the Scandinavian stone men; but in other respects it differs very widely from them, being in the first place far more capacious, and very wide, especially in the frontal region, remarkably even in contour, and with a look altogether of higher breeding. The superciliary arches are thin and fine, totally unlike the beetle brows of the old Danes; and the remains of the *ossa nasi* show that he had a prominent, thin, and, may be, aquiline nose. The lower jaw is light in comparison, and the angle prominent, as is common, I believe, in what are termed the Roman crania by Davis and Thurnam. On the whole, I am inclined to refer it to a much later period than the stone, notwithstanding the fossilized condition of the bones; but it would be very interesting to find some articles with it. . . . The shape at vertex is flattened, and not so pyramidal as the true stone skulls.

"I am yours truly,

"Geo. Busk."

It is, of course, hardly necessary to say that I coincide entirely in these observations; and do not doubt that my readers will be pleased to hear that a decade of "Priscan crania" is now completed, and will shortly be published by Professor Busk, in addition to his magnificent 'Crania Typica.'

I am also indebted to Professor Busk, F.R.S., for the beautiful and accurate outline of the Kellet skull, taken in four different aspects; and to Mr. S. J. Mackie, F.G.S., for the drawings of the frontal bone (B) from Heathery Burn, and the Leicester skull, referred to by me in the 'Geologist,' vol. v. p. 313. The Kellet skull will be ultimately deposited in the Ethnological Society's collection.—Charles Carter Blake.

Human Remains in River Beds.—Sir,—No better proof can be given of the accuracy of the observations in your comments on the Geologist's Association ('Geologist,' vol. v. p. 320) that the geology of the neighbourhood of London affords many yet unexplored topics of interest, than the following scattered facts:—

John Hunter, writing about the year 1793, quotes a letter which he had received from Sir James Hall, of Scotland, dated Rome, February 24th, 1785.

In this letter a hill is described that lies about three miles from Rome, in the road to Loretto. "It is about 300 or 400 yards beyond an old tower, called Torre del Quinto. A tomb, called Ovid's, is dug into it; and 50 or 60 yards nearer Rome is a gravel-pit, which is the spot in question. The hill terminates abruptly in a vertical crag, at the foot of which the road passes, leaving it on the left-hand as one goes from Rome. This crag exhibits the internal structure of the mass, which consists of horizontal strata. The hill is about 100 feet high above the level of the plain along which it passes:—

"1st. The upper part, on which the vegetable earth rests, is a bed 60 or 80 feet thick, of a kind of tufa or soft volcanic stone, full of lumps of black pumice of the size of a fist, more or less.

"2nd. A stratum of rolled pebbles, of various kinds of stone, some calcareous, some flinty, and some pumice. In general they have undergone some action, which makes them crumble when taken out; in some places they are bound by a calcareous cement, and in others little attached, and mixed with sand. This stratum is about 3 feet thick in one place, and tapers from right to left to the thickness of a few inches, on an extent of 30 or 40 yards. . . .

"We found the bones contained in this box in the first stratum of gravel between the two beds of tufa. We got up to this place by a bank formed by the crumbling of the hill above, and the matters thrown out of the gravel-pit on the right side of it. There is the greatest reason to suppose that the place where they were found had never been moved since the tufa came there; that is, that the bones and the stones of the stratum were placed there by the same cause, and previous to the formation of the upper bed of tufa [viz. that which is 60 or 80 feet thick].

"The place in which we found the bones extends 8 or 9 feet from right to left, and probably goes further to the left in that place, where the stratum of gravel passes along the roof of the gravel-pit; but there it was inaccessible. We did not dig anywhere above 3 feet into the bank, being afraid of bringing down the rock above by undermining it. It appears certain that the bones were brought there, along with the pebbles, loose, as bones, not in carcasses, for they lie scattered together without the least connection; and their number is so great, compared to the space they occupy, that there would not have been room for so many bodies.

"Their nature is various, and indicates the presence of at least five or six distinct kinds of land-animals, and, among the rest, two individuals of the human species.—J. HALL."

"This hill [Hunter proceeds to say] must have been formed before the Romans took possession of this place, and probably by the formation of the hill. The Tiber made its way in this direction, for it cuts the hill across. This is probably the only instance met with of human bones being in such a state. But in future ages, when the present rivers may take a new turn [through localities] in which are deposited human bones, many may be found; for in sinking the caissons for Blackfriars Bridge a human skull was found 12 feet under the bed of the river." *

On the table of the Ethnological Society, on March 18th last, I placed, through the kindness of Mr. Sass, specimens of chipped flints from the valley of the Thames at Blackfriars Bridge, and from Teddington Lock. These flints, though not of the highest geologico-archæological antiquity, yet by their simplicity of workmanship indicated a race which had progressed but little towards civilization. I am not in possession of any information as to the depth at which these remains were found.

Mr. Mackie has drawn my attention to three skulls recently deposited

* Hunter, 'Essays and Observations on Natural History,' by Professor Owen, vol. i. p. 321.

in the Antiquities Department of the British Museum, by Mr. Franks, which were derived from the bed of the Thames, at Battersea. I have not yet been able to give them the attention which they merit, but shall compare them with the East Ham, Kellet, and Leicester skulls, which they resemble more than they do the Sennen, Borris, Blackwater, Muskham, etc., series of true "river-bed" skulls.

I trust that all further evidences of human bones or works that may occur in or near London will be carefully recorded, and that above all, whenever there are *geological* evidences of antiquity such evidences may be thoroughly sifted and properly recorded in the same careful manner as was done in the case of the Heathery Burn relics, under the effective direction of the editor of this journal.—CHARLES CARTER BLAKE.

VEGETABLE REMAINS AT BOURNEMOUTH.—Sir,—Making inquiries to-day of a labouring man employed in a gravel-pit, as to whether he had ever met with animal remains in the gravel, or shells below it, he gave the following as the only instance of the sort within his own knowledge:—

"About eight years ago, whilst working in a pit for white clay, which is sent to Staffordshire, at a place about one mile on the Poole side of Bournemouth, in Dorsetshire, at forty-two feet below the surface we came upon an oak-tree two feet in diameter. At first it seemed hard, but on exposure to the air it could be broken away with the nail; the *leaves* were there in the clay, entire, but we could not succeed in removing any of them: they all came to pieces; although we tried every means to do so, placing them between the leaves of books, as some of the ladies there wished to have them."

Further inquiry on the spot, by any one who had the opportunity, might be interesting, if the case has not already been recorded.

I am, your obedient Servant,

Southampton, October 1*st*, 1862. W. N.

FOSSIL MONKEY IN THE MIOCENE.—The following announcement is made in Professor Owen's recently published memoir, "On the Osteology of the Chimpanzees and Orangs," in the Zoological Society's Transactions, page 18:—

"I have been favoured by Dr. Kaup with the cast of a fossil femur from the Eppelsheim miocene, near Darmstadt, and with the request that I would compare it with the femora of the large anthropoid apes in our metropolitan museums. This femur is 11 inches 3 lines in length, is 2 inches across the proximal, and 1 inch 7 lines across the distal end; and measures 2 inches 4 lines in circumference. It retains all the lower quadrumanal characters of the bone, with nearly the gibbon-like proportions as to length and slenderness. The shaft is straight, without the least forward bend; the distal end becomes gradually and almost symmetrically expanded, and in an inferior degree to that in the chimpanzee, gorilla, and man; the backward projection of the condyles is much less. The linea aspera is as little marked as in the gibbons; the neck of the thigh-bone is as short, and the head as small, relatively, as in the gibbons; all the modifications, in fact, relating to the use of the lower limb in maintaining the erect position, and which, in their respective degrees, are found in the chimpanzee and gorilla, marking their progressive approaches to the peculiar human attitude, are as completely wanting in the fossil femur as in that of the recent ungkas and gibbons; whence we may infer that during the miocene period there existed, in the locality haunted by the ape that has left its remains at Eppelsheim, a richly wooded tract, in which a gibbon, or long-armed ape, of twice the size of those of the Eastern Indian Archipelago, enjoyed a strictly arboreal life. The shape of the shaft of the supposed humerus of the *Dryopithecus*, from the miocene of the South of France, as figured in M. Lartet's memoir (*Comptes Rendus de l'Académie des Sciences, Juillet* 28, 1856), agrees with that of the Eppelsheim femur."

Irish Drift Fossils.—The rarity of the occurrence of fossils in the deposit known as the "Drift," which extends far and wide over the low country in Ireland, may excuse the following communication.

For a long time past I have taken advantage of opportunities to search these gravels, clays, and sands, in the hope of finding even a fragment of a drift fossil, but until lately without success:—In the early part of last month, however, I was driving from the town of Sligo southwards, towards the micaceous and gneissose range (continuous with the Ox Chain), which passes along the southern shore of Lough Gill, and near the foot of these mountains having observed a tract of drift hillocks stretching from the lake to Ballysodare Bay, I stopped to examine a gravel pit in one of them beside the road, situated in the townland of Drumiskybole, and about two miles from the sea. It appeared to have been opened at first to a depth of about five feet, and a smaller pit was sunk within it to a vertical depth of some six feet more; apparently, to obtain fine sand, like that on the seashore, which occurred irregularly amongst coarse gravel and small boulders of the local rocks; the sand predominating at the bottom of the pit. I searched in this sand with no better success than usual, but was surprised to find in the vertical side of the pit, within three feet of the top, a cluster of mussel shells, together with small, decayed, woody fragments among the coarser rubble. The place immediately over and about the shells bore no trace of having been disturbed, while a couple of feet above them the upper edge of the pit had somewhat this appearance. The shells lay in irregular positions, rather than upon their sides, in the interstices between the stones; some of which, just above them, were nearly a foot long. Many of the shells were unbroken, some were closed, and they seemed to have slipped downwards into where I found them, but there was no trace whatever of a space large enough for them to have passed through in the overlying and apparently undisturbed gravel. I have them by me now, and they resemble in almost every respect the dead shells which might be found along the seashore, except that they are not so clean. From the position in which I found them, if they were there before the pit was opened, they must have been some seven feet below the surface of the hill, and I saw nothing about the place to show that they had been artificially introduced since. The rarity of the occurrence only, led me to look about the neighbouring fields, where I saw that the ground, as is usual in that country, had been manured with seaweed, along with which such shells might possibly have been brought from the sea; but I found nothing to connect this circumstance with the occurrence of the shells in the gravel-pit, and I only mention it to show that it was not overlooked, in case there should exist a remote possibility of the shells I found having been brought in this way.

On the other hand, supposing the shells to have been really *in situ*, was it equally as likely that they would be found in the coarse gravel, etc., as in the fine sand beneath?

The general uncertainty regarding the contents of most drift deposits would have prompted me to leave the shells where they were, if it did not seem more likely that they would come down and be carried away in some of the next few cart-loads of sand taken from the pit, than that they would ever be visited by any one so accustomed to finding drift fossils as to be able to say whether they were really in place or not.

I have only to add, that such shells as have been hitherto found in the "drift" in Ireland, so far as I know, belong, like these, to existing species; and amongst the few localities for them of which I have heard, to mention the discovery of shells in a fragmentary state in the drift of the Dublin Mountains, by Professor Kinahan, and the allusion made by R. Mallett, Esq., at the last meeting of the British Association, to the occurrence of whelks found by him in a gravel-pit near Moate, county Westmeath.

I must apologize for the length of this note, and remain, etc.,

Athlone, August 22nd, 1862. A. B. Wynne.

Footprints in Carboniferous Rocks.—Sir,—I send you a drawing of a footprint, which is upon a boulder from one of the rocks of

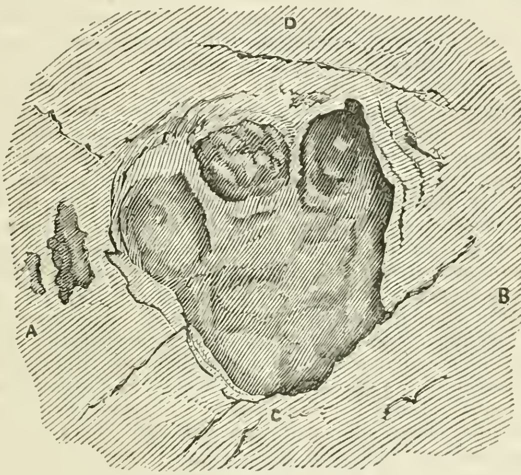


Fig. 1.—Ground-plan of footprint.

the carboniferous series. It was found in the drift, which overlies in part the Magnesian Limestone and the uppermost members of the carboniferous strata, and which is entirely composed of carboniferous rocks. The boulder is a hard sandstone, bearing traces of Stigmaria.—Yours truly, T.

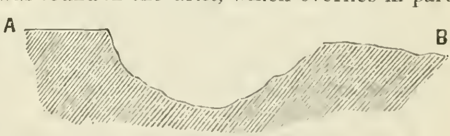


Fig. 2.—Vertical cross section.

This footprint appears to be an interesting addition to Ichnology. The footprints from the Forest of Dean and from near Edinburgh ('Siluria,' 2nd edit. p. 323), are, we think, the only known specimens in British coal-rocks, besides Mr. Binney's specimen from the Millstone Grit. In North America there are some still lower in the carboniferous series.—Ed. Geol.

Fig. 3.—Vertical longitudinal section.

Eosaurus Acadianus.—'Silliman's Journal' for July contains an excellent description, with figures, of two portions of vertebræ of a new Enaliosaurian from the coal-formation of Nova Scotia, by Mr. O. C. Marsh. Reptilian remains from the coal-measures have hitherto been few in number, and have been nearly all regarded as Batrachian or Amphibian. The present remains were embedded in a stratum of argillaceous chocolate-coloured shale, which forms part of Group XXVI. of the section made of the South Joggins coal-formation, in 1852, by Lyell and Dawson, and is about 800 feet above the level of the beds which have furnished the *Dendrerpeton* and *Hylonomus*. These remains are those found in 1855 by Mr. Marsh, and referred to at page 110 of this journal.

Great American Desert. — In their acquisitions from Mexico the Americans have acquired not only good, bad, and indifferent lands, but they have also acquired the Great Colorado Desert, extending from the base of San Bernardino south-westwards, for 180 miles, and having a superficial area of 9000 square miles. Excepting the Colorado the whole of that district is without river or lake, and the desert stretches off to the horizon on all sides without a vestige of vegetation or life. Its surface is ashy and parched; its frame of mountains rise in rugged pinnacles of brown rock, bare even of soil. Words are unequal to the task of describing its wide expanse, the purity of its air, the silence of its night, the brilliance of the stars which shine over it, the glare of the mid-day sun, and the violence of storms of dust and sand. Parts are even destitute of the latter, and present a surface of smooth, compact, sun-baked clay. Other parts are covered with heaps of sand, in depths of fifty to eighty feet high. Near the mountains along the Colorado is a perfectly flat terrace paved with pebbles, of nearly uniform size, of porphyry, jasper, quartz, carnelian, and agate, all rounded by the action of water, and polished till they glisten by the driven sand. The northern part of the desert is thought to be the dry bed of an ancient freshwater lake, the beach lines of which are strongly marked; and probably, at a comparatively recent period, the waters of the Californian Gulf covered all the clay portions of the area, which are still below its level; and if a channel were cut through the natural embankment of the Colorado these portions, at least, of the desert, would be doubtless again covered. It is even proposed to effect an outflow of the river for the fertilization of this vast arid tract by an artificial irrigation.

It is possible that the Colorado district may have been elevated within historic or immediately prehistoric times, as earthquakes still agitate that region; and in 1852 there were eruptions of mud and hot water in the central parts of the valley.

Fossil Fish in Magnesian Limestone.—There has recently occurred in the Magnesian Limestone at Fulwyll Hill some interesting examples of fossil fish. The specimens belong to three or probably four species of *Palæoniscus,* and to a single species of *Acrolepis*. Those of the former genus are by far more common, and nearly all of them belong to one species. Specimens of *Acrolepis* are exceedingly rare. Three species of Palæoniscus have been described by Mr. J. W. Kirby under the names of *P. varians*, *P. latus*, and *P. Abbsii*. They are all small, the largest not being more than four inches in length. Along with the fish have been found traces of terrestrial plants. Most of these fossils are found in a bed of slaty and laminated limestone, not more than two feet thick, and only a short distance from the base of the "Upper Limestone." The occurrence of fish in this subdivision is interesting, as no remains of higher organization than mollusca had been previously known to exist in it; nearly all the vertebrata of the Permian series of the district being confined to the marl-slate near the bottom of the formation. They are, in fact, the last, as far as is known, of the Palæozoic vertebrates; and those which approach nearest in time to the higher forms of life in the succeeding or Mesozoic period.

Animal Remains in Irish Peat Bogs.—In the 'Archæologia' (No. 1776), vol. ii. p. 359, is "An Account of some Antique Curiosities found in a small Bog near Cullen, co. Tipperary," by Governor Pownall, which consists chiefly of records of gold articles found by various poor people there. The following two passages are all that relate to animal remains. "In digging away the bog, about 6 feet deep, as far as it extended, there was nothing only trunks of different trees all rotten, except the oak and fir, which were for the most part found, and some horns, large enough to have a circle of three feet in diameter described on each palm." "A.D. 1773. A man found in digging the bog, a skull with two horns shaped like those on Kerry sheep, but longer. No person who has seen it can tell to what beast the skull belonged."

Mammalian Remains.—The drift-bed at Aylesford, Kent, has just yielded a lower jaw of Mammoth in good preservation, with molars in their sockets. Close to it was found a tusk much curved, eight feet long, and perfect for the entire length, no doubt belonging to the same individual. It is to be hoped these specimens will be preserved in the Maidstone Museum.

Mammoth Remains.—In an extract from the Minute Book of the Cambridge Philosophical Society, 20th November, 1821, there is a notice of fossil organic remains found near Streatham, in the Isle of Ely, by Dr. Frederick Thackeray.* He says, "The finest examples of organic remains characteristic of beds of alluvium rather rest upon the line of junction between clay and gravel than in the gravel itself." He adds, "A very considerable part of the skeleton of a mammoth was lately found in a gravel-pit near Chatteris."

Fossil Monkeys.—The references to *Eopithecus Colchesteri*, Owen (*Macacus eocænus*, Owen), from the Kyson sand, in Suffolk, made in my article on "Fossil Monkeys" ('Geologist,' vol. v. pp. 82, 83, 85), are cancelled, as well as any other reference to Eocene monkeys.—Charles Carter Blake.

Erratum.—In my table of the association of human remains with those of extinct and recent Mammalia, p. 228, in the column headed "Massat," crosses should be inserted opposite *Felis spelæa*, *Ursus spelæus*, and *Hyæna spelæa*; in the column headed "Valley of the Trent," the cross opposite *Cervus megaceros* should be erased, and crosses inserted opposite *Canis lupus* and *C. familiaris*. Two extinct species of Mammalia were consequently found with the Muskham skull, and five existing species.

Charles Carter Blake.

Mammoth Remains.—Mr. A. B. Ruhmond, of Meadville, Pennsylvania, records in the 'Scientific American' the discovery of mammoth remains in the excavations of the Atlantic and Great Western Railway at French Creek, Crawford County.

Discoveries of Lake-Habitations.—A statement appears in the 'Anzeiger für Kunde der Deutschen Vorzeit,' of Nürnberg, for July, that at Müncheberg, at a depth of 18 feet, workmen who were making an excavation for a new brewhouse discovered a *Pfahlwerk*, or Lake-dwelling, containing much dung, animal bones, and stags' horns. Another pilework had been discovered in Frauenfeld (Thurgau), which has only been partially examined.

* A fossil bone, of what species is not stated. The specimen was presented to the Cambridge Museum by Dr. Thackeray.—Ed. Geol.

Geological Age of the Australian Fauna.—Mr. Ludwig Becker, in the Transactions of the Philosophical Institute (now the Royal Society) of Victoria, contributed a paper on the age of the animal and vegetable kingdoms of Australia relatively to that of the rest of the world, in which Professor Phillips's belief that the fauna and flora of the Australian continent is that of the long-past Oolitic age, is supported, and additional proofs given of its correctness; the result finally arrived at by Mr. Becker being, that "the existing Australian fauna is the oldest living animal kingdom; that a great number of trees and flowers, planted in Oolitic times, are still blooming in Australia; and that the present external form of this portion of the earth is the oldest aspect of the earth preserved in these times." As these opinions have been, to a certain extent, contested by Mr. David Page in his eloquent little work on the 'World's Life-System' (8vo, Lond., 1861), it is interesting to find them supported by a geologist resident at the Antipodes.

Separation of the Isle of Wight.—Sir,—Might I again trouble you with the question about the date of the separation of the Isle of Wight from the mainland.

I have never yet met with any specific statement of the supposed time of the occurrence, and should like to know how far science supports the curious passage in 'Diodorus Siculus,' which is supposed to allude to that island; but where the writer states that in his day, at low tide, the channel between the island and the mainland was dry, and passable for carts and traffic.—A Constant Reader, *Lymington, Hants.*

FOREIGN INTELLIGENCE.

The Baron l'Espine, medical inspector of the waters of Aix, in Savoy, has communicated a note to the French Academy, "On the Recent Discovery of Lacustrine Dwellings in the Lake of Bourget, near Chambery." The lake is about ten miles long and two broad, and, amongst other objects found in the exploration of its depths, he records a fragment of coarse pottery formed of black clay, and similar to the Celtic vases in the collection of M. Boucher de Perthes.

Excavations have been recently made in the grotto Da Portel, in the commune of Coubens (Arriége). The grotto is situated at four hundred mètres above the sea, and has but one entrance, at the extremity of the Bois de la Peyrade. By M. Troyes' labours here there have been brought to light a few fragments of pottery, ancient and modern, and a few bones of sheep and dogs near the surface. At a further depth the bones of bears of three distinct sizes, two of which were at least equal in stature to the horse; the third was much smaller, but different from the bear of the present day.* The other remains comprised those of dogs, wolves, hyænas, pigs, a large kind of ox, reindeer,† and another ruminant, probably antelope.‡ Three implements of human manufacture have been

* Query, *Ursus spelæus*, *priscus*, and *arctoideus*.

† Remains of reindeer have been found in the bone-cave of Aurignac.

‡ Query, the chamois (*Antilope rupicapra*), remains of which have been found at Massat, and in the Pfahlbauten of Switzerland.

found: one a hatchet, roughly cut out of limestone; the others being serrated lance-heads of different sizes. No human bones have as yet been discovered, though there is reason to believe that the cavern was frequented by man from the earliest period.

The great works which have recently been going on at the citadel of Antwerp have been made to do good service to geology by M. Dejardin, the captain of engineers in charge of them, who has rendered account of two admirable sections to the Belgian Academy. One, commencing at the old citadel on the south, follows the principal trench, approaches nearly to the new citadel on the north, and ends at one of the outworks near the Scheldt. The other section begins at the Scheldt above the city, at a place called Den Berg, in the prolongation of the principal face of No. 8 Fort at Hoboken, and terminating at the right extremity of the Campine canal. The deposits shown are—

Modern Period......	1. Vegetable earth. 2. Ferruginous sand. 3. Peat.
Diluvial Period......	4. Campinian sand.
Scaldisian Period ...	5. Argillaceous sands. 6. Grey sand.
Diestian Period......	7. Green sand. 8. Black sand.
Rupelian Period ...	9. Argillaceous marl.

The peat is, M. Dewall thinks, of very modern origin, as it contains bones of animals of species still living in the country, and arms and pottery belonging to periods not very remote. It contains also undecayed stems of vegetables. The Campinian sand is formed of grains of white quartz, coated with various substances, chiefly hydrate of iron, and indurated clay. It is entirely devoid of shells. At the base of these sands there is a bed of quartz pebbles mingled with small teeth of fishes. This is probably a band of the "Cailloux Ardennais." At the top of this bed there have been found mammoth grinders, and a part of a skull with gigantic horns.

The Scaldisian deposits consist of an upper yellow argillaceous sand (No. 5), containing teeth of sharks (*Squalus*, *Carcharodon*, *Oxyrhina*, *Trigonodon*, *Lamna*), seal, and ziphius, etc.; ear-bones of Balænoptera; and casts of shells in indurated clay or ferruginous sandstone. Below this are other argillaceous sands, with considerable quantities of broken shells; and from the list of these species given by various naturalists, this deposit would seem to be the equivalent of the Red Crag or Coralline Crag of Suffolk. The fossils contained in this deposit are those in the lists nos. 33 and 34 of M. D'Omalius, in his 'Géologie de la Belgique.' Below these argillaceous sands is a grey sand, containing the same fossil shells and bones. At the base of this bed blocks are met with formed of grains of quartz and glauconite, consolidated probably by the dissolution of the shells, and having usually as nuclei shells, bones, or small branches of trees. The latter are often decomposed, giving rise to cavities in the stone. Amongst the fossils of this deposit are the jaws and teeth of the *Squalodon Antverpiensis*. *Pecten Lamallii*, *Terebratula perforans*, and a species of *Spatangus*, occur in great numbers. *Ditrupa subulata*, bryozoons, *Lingula Dumortieri*, and *Terebratula Sowerbiana*, are also met with.

The *Sable vert* of the 'Système Diestien" next follows. It contains hardly any shells or bones, and those met with are of particular species. Quantities of oyster-shells are seen, and *Isocardia lunulata* is also very abundant. Between the green and black sand there is met with at Kiel a bed of ferruginous clay, about a foot thick. The "black sand" is a very important deposit, both on account of the thickness and the number of fossils it contains. It is the equivalent of the "black crag" or "glauconite crag." As this deposit has nowhere been penetrated in the excavations, its thickness is not known. The chief shell is the *Pectunculus variabilis*.

The "Système Rupèlien" is solely represented by the "marne argilleuse," which is found at Fort no. 8, and in the brickfields of Edeghem. It is a black or bronze-coloured clay, containing concretions of pyrites and septariæ, often incrusting *Nautilus Aturi*. It also contains flint-pebbles and teeth of *Carcharodon heterodon*.

REVIEW.

Essays and Observations on Natural History, Anatomy, Physiology, Psychology, and Geology. By John Hunter, F.R.S. Being his Posthumous Papers on those subjects, arranged and revised, with Notes, by Richard Owen, F.R.S., D.C.L., Superintendent of the Natural History Department, British Museum, etc. etc. John Van Voorst.

The aphorism of Niebuhr, that "he who calls what has vanished back again into being, enjoys a bliss like that of creating," which has been quoted by almost every geologist from Lyell downwards, is nowhere more applicable than to the discovery and safe transmission to the thinking scientific men of the present day of the long-lost Hunterian manuscripts, and especially on that on Geology, to which we shall draw our readers' attention.

John Hunter, after communicating to the Royal Society of London, in 1793, his paper "on the Fossil Bones presented to that Society by His Most Serene Highness the Margrave of Anspach" ('Philosophical Transactions,' vol. lxxxiv. 1794), followed up the subject by a second memoir, summing up the conclusions which he had deduced from his study of "Extraneous Fossils" in general. This manuscript he communicated to the Royal Society, with the following result:—

"The attention of the Secretaries or Council of the Royal Society had been called, by some of the Fellows, to the expressions in the first paper, on the 'thousands of years' required for such and such geological phenomena; and, in the second memoir, the Secretaries found that a chronology of the earth, widely different from the usually accepted one, was more directly and emphatically affirmed by the author, as essential to the rational comprehension of the phenomena he treated of, while, at the same time, the adequacy of the chief or sole geological dynamic at that time recognised, viz. the Mosaic Deluge, to account for the presence of marine fossils on land, was called in question. Considerations for the repute and interests of the author himself may have swayed his advisers in the recommendation to him to submit the manuscript to a geological friend, before finally sending it in for formal acceptance and perusal before the Society. Major Rennell, author of some papers in the 'Philosophical Transactions' on 'Tides and Currents,' and other geographical subjects, undertook the delicate task of submitting to Hunter the misgivings of the authorities mainly responsible for the publications of the Royal Society. He did it in these words: 'This leads me to remark that, in page 3, you have used the term 'many thousand centuries,' which brings us almost to the *yogues* of the Hindoos. Now, although I have no quarrel with any opinions relating to the antiquity of the globe, yet there are a description of persons very numerous and very respectable in every point but their pardonable superstitions, who will dislike any mention of a specific period that ascends beyond 6000 years: I would, therefore, with submission, qualify the expression by many thousand *years*, instead of *centuries*.' Hunter would not modify his statements, and he withdrew the paper."

An edition of this paper was hurriedly printed by the Council of the Royal College of Surgeons in December, 1859: the more important passages are inserted in the work before us, in which Professor Owen says—

"Some may wish that the world had never known that Hunter thought so differently on some subjects from what they believed, and would have desired, him to think. But he has chosen to leave a record of his thoughts, and, under the circumstances in which that record has come into my hands, I have felt myself bound to add it to the common intellectual property of mankind."

The great geological principle, the coevality of the fossils with the mineral strata in which they are found, which some geologists have denied, was formally asserted by Hunter. He said—

"Finding upon land more parts of marine than terrestrial animals preserved, and at considerable depth, it naturally leads to the idea of sea-animals at least having undergone this process at the bottom of the sea; and if so, then as that [stratum] in which they are found is now land, and as we find parts of land-animals and vegetables preserved nearly in the same manner, it leads us into a more extensive investigation of the permanency of the situation of the waters; and in this inquiry we shall find that wherever an extraneous fossil is enclosed or imbedded, the surrounding native matrix was accumulated, disposed, or formed into that mass at the same time."

Professor Owen remarks on this—

"I do not find this proposition so definitely laid down in geological writers prior to Hunter; although it was evidently appreciated in a certain degree, and with reference to particular strata, by some of Hunter's predecessors.

"The exceptions to the rule arise from the formation of one stratum out of the ruins of a preceding fossiliferous stratum, when the fossils of that older stratum become, together with their matrix, a part of the newer one, with which, however, those fossils are far from being coeval in respect of the period when they actually became fossil. Petrified bones of Plesiosaurus, *e. g.*, have been transmitted to me, together with unpetrified bones of the beaver, from the comparatively recent 'till' of Cambridgeshire, the plesiosaurian remains having been washed out of the subjacent gault, when the sea finally retired from the uprising land. Such 'derivative' fossils were nevertheless actually enclosed or imbedded in the newer tertiary matrix when it 'was disposed or formed into the mass,' now called 'till.' The exceptions of such derivative fossils are, however, comparatively rare, and do not affect the conclusions, as to the relative age of a stratum, afforded by its obviously and much more abundant proper organic remains."

"We find," Hunter proceeds to say, "the remains of sea-animals in every kind of substance excepting granite. We find wood, bones of sea-animals, bones of land-animals, in freestone, gravel, clay, marl, loam, and peat."

Professor Owen remarks—

"With regard to the alterations of climate which Hunter deduced from the supposed identification of some of his fossils with those of recent animals, he was induced to refer the circumstance to 'a change in the situation of this globe respecting the sun,'—in other words, to a 'change in the ecliptic.' Here he departs from his principle of explaining the past phenomena by present causes. Newton long since declared, in reference to a similar supposition borrowed by Burnet from an Italian author, Allessandro degli Allessandri, in the beginning of the eighteenth century, that 'there was every presumption in astronomy against any former change in the inclination of the earth's axis;' and Laplace has since strengthened the arguments of Newton, against the probability of any former revolution of this kind.

"It may be a question, however, whether the mental stock now to be dealt with by the geologist does not yield a truer appreciation of the duration of time in which the movements of the stellar and solar systems have gone on, than could be afforded by the observations and calculations of the astronomer in the times of Newton and Laplace: whether the inadequacy of the analogy, based by Cuvier on the knowledge of the characters of a species during a period of 3000 years, of such seeming fixity of specific characters, to the effects of influences on generations succeeding each other during 300,000 years, may not be applicable to the case of Newton, considering the results of his observations and calculations under a preoccupation of the mind by the theological age of the world.

"Hunter's recourse to 'a change in the ecliptic,' as well as to 'some attractive external principle producing a great and permanent tide,' such as Whiston's comet, *e.g.*, was however the consequence of a misconception or misinterpretation of the phenomena which those hypothetical causes were invoked to explain.

"Hunter believed, for example, that the elephants' remains found in northern and temperate latitudes belonged to the same species, or at most to a variety of the same species of elephant, as that which now lives in tropical regions. Its specific distinction from the existing tropical elephants was then as little understood as the specific distinction of the African from the Asiatic elephants.

"The moment that zoology and comparative anatomy had made such progress as to discern constant differences interpreted as specific distinctions, and to apply the same principle to the differentiation of the fossil elephant of northern regions from either of the existing tropical kinds, the necessity for calling in a cataclysm, either through a hypothetical shift in the ecliptic, or the attraction of the ocean upon the continents by a comet, no longer existed."

Hunter's observations on the inadequacy of a pre-supposed Mosaic deluge to account for the manifold evidences of aqueous action which geology has revealed to us, we must quote:—

"History gives us no determined account of this change of the waters; but as the Sacred History mentions the whole surface of the earth having been deluged with water, the natural historians have laid hold of this, and have conceived that it would account for the whole. Forty days' water overflowing the dry land could not have brought such quantities of sea-productions on its surface; nor can we suppose thence, taking all possible circumstances into consideration, that it remained long on the whole surface of the earth; therefore there was no time for their being fossilized; they could only have been left, and exposed on the surface. But it would appear that the sea has more than once made its incursions on the same place; for the mixture of land- and sea-productions now found on the land is a proof of at least two changes having taken place."

Professor Owen, addressing his audience at the College of Surgeons on March 10th, 1855, on this subject, said,—

"The close similarity, in the clear and philosophical views and words of Fracastoro, to those of Hunter (who we may safely believe had never read, or probably heard of the Italian author), are very striking. I need not trespass on your time by recounting the hundredfold additional and diversified testimony, which God, in his wisdom, has suffered to be made manifest, and to be irresistible in producing conviction according to the means of appreciating truth with which He has been pleased to endow the human understanding, in demonstrating the utter inadequacy of any of the brief and transient traditional deluges to account for observed geological and palæontological phenomena.

"As the astronomer in teaching his science gives the results of the exercise of those faculties of observation, comparison, and calculation which have been given to him for the purpose of making known the creative operations in infinite space, without enlisting any aid or element of science from the records of Creation in the sacred history of the Jews, so ought the naturalist or geologist equally to abstain from any foregone conclusion as to mode or time of operation which he might believe himself able to derive from divine teachings given for another end. He ought to confine himself to the deductions which rest on observation and experiment, and to teach those natural truths only which he has been privileged to establish by the exercise of the talents entrusted to him for the discovery of the creative operations, or the power of God, in the immeasurable periods of the past.

"We find in the remarkable essay recovered from his posthumous manuscripts some instances of the results of the special application of those principles to particular geological phenomena.

"Take those which must have most frequently presented themselves to his observation, as *e. g.* in the valley of the Thames, and note the broad interpretation that he gives of the facts so observed. 'Probably,' he writes, 'the whole flat tract of the river Thames, between its lateral hills, was an arm of the sea; and as the German Ocean became shallower, it was gradually reduced to a river: and the composition of this tract of land, for an immense depth, would show it, viz. a gravel, a sand, and a clay, with fossil shells in the clay 200 or 300 feet deep, all deposited when it was an arm of the sea, and above which are found the bones of land-animals, where it has been shallow.'"—P. xv.

Owen goes on to say,—

"Hunter does not, indeed, specify the nature of the shells: they are, however, of a kind that could leave no doubt on his mind of their marine character. With his fossil specimen of *Strombus coronatus*, Dfr., he has placed the recent *Strombus accipitrinus* from the South American seas. He had also obtained *Rostellaria macroptera*, Lam., from the eocene tertiary at Hordwell, Hants.; *Voluta nodosa*, Sby., from the London clay; *Mitra elongata*, Lam., from the eocene at Grignon, near Paris; the gigantic *Cerithium*, from the same formation and locality; the *Crassatella tumida*, Dh., from Nummulitic strata of the Swiss Alps; and the great *Nautilus imperialis* from Sheppey, so like the pearly Nautilus from the Indian seas. All these shells, selected from a hundred other specimens in Hunter's cabinet, must have presented to their collector unmistakeable features of the marine origin of the strata containing them.

"Subsequent researches, aided by the refined conchology of modern science, have established the truth of Hunter's conclusion.

"All the shells of the London clay which forms the bottom of the tract through which the major part of the Thames flows, are of marine species, and most of them extinct. In the superficial gravel have been found fluviatile shells, most of them of recent species, with the remains of elephant, rhinoceros, hippopotamus, and other large terrestrial quadrupeds."

As regards earthquakes, as a geological dynamic, Hunter states—

"I formerly observed that earthquakes very probably raised islands; that on the surface of such there would be found shells, and in vast quantity, recent, dead, and fossilized. . . . This upraising of the bottom of the sea above the surface of the water, will also raise up along with it all the shell-fish that lay on the surface of the bottom, as also dead shells, and in the substance of the earth all the deeper-seated substances imbedded or enclosed in stone, chalk, clay, etc., which I have said constitutes the true fossil. This appears to be the state of the case on and in the Island of Ascension; the whole surface of this island is covered with shells, and some so perfect as to have their ligaments still adhering. There is, besides, a vast quantity of lava, and other volcanic matter, all of which shows it most probably arose in this way; because such recent alteration in the sea, so as to have exposed so much of its bottom, and so recently as to have the animal part of the shell still adhering, *and the very name implies its rise.* I suspect that many of those shells found on land near the surface, on the tops of mountains, have been exposed in this way."—P. xlvii.

Owen remarks on the ridiculous derivation of the name of the island:—

"This is very ingenious; but the superstitious Spaniard had little thought of the geological causes of the island, when he discovered it on the evening of 'Ascension Day.'"

Poor João de Nova Galego little expected that he should be thus misquoted in the eighteenth century.

With respect to the conditions under which mammalian remains are imbedded in comparatively recent geological deposits, Hunter wrote—

"In peat, one could conceive that the trees had only to fall, and afterwards to sink down into it; but I believe no such wood grows in peat, therefore they must have been brought there, and that only by water; or [they may have] grown there prior to the formation of peat. But the animals which could come there had only to die on the surface, and in time they would also sink deeper and deeper into it; and this I imagine might be the case with the beavers in this country, whose bones are found in the peat-mosses in Berkshire. Or, as peat is supposed to grow, we can conceive it rising higher and higher above such substance.

"Bones are also found in gravel, clay, marl, loam, etc.; and as we have found the sea-horse bones [*Hippopotamus*] in gravel, etc. in this country, I am inclined to think that such situations have been shores or arms of the sea, at last constituting mouths of rivers, where the animals have been accidentally swept away by floods, accidentally drowned, etc., where gravel, clay, etc. have subsided, as before described; for it gives more the idea of being a consequence of the sea leaving the land than an effect produced by a continuance of the sea in the part, according to our idea of the formation of the true fossil. But the difficulty is to apply this to the bones of some animals that do not now exist in the same countries where they are found; as also [to] the bones of animals that probably do not now exist in any country.

"This looks like a destruction of the whole species of such animals at the time [during] which [those] animals were probably confined to such countries; and which might also be the case with the beaver in this country; and it being a more universal animal, its species is preserved in other parts. The same observations apply to the sea-horse [*Hippopotamus*], as also to the elephant." . . . .

"Thus we have in many parts of this island the bones of unknown animals, such as a large species of deer [*Megaceros*], as also the core of the horns, and bones of some very large animals of the bull kind" [*Bison priscus*, *Bos primigenius*].

With respect to the nature of the animals imbedded in various strata,—

"We may observe that the amphibia, and such as inhabit both the sea and land, as all of the Phoca-tribe, white bear, etc., likewise sea-fowl, partake of the before-mentioned mode of fossilization, by dying in the sea; for wherever there has been a shore, there we shall find the amphibia; as also many of the fowl-tribe, called sea-fowl, which feed in the water, which may die in the sea near the shore, or be brought down in the rivers, will be carried into the sea, and be fossilized according to the fore-mentioned method, and will be found along with the sea productions. But they will also partake of the second situation, as in large valleys leading to the sea, which were formerly arms of the sea or inlets, which are to be considered as having been moving shores, as the sea gradually leaves the land, leaving materials it had robbed higher land of, raising the bottom, or forming a new surface, lessening the depth of water at these places, which renders it slower and slower in its motion, as before described, at last becoming a river. Such new land will bury in it such productions, whether of sea or land, but most of those common to both, as shall either die in it, or being brought into it, constituting chiefly such animals that inhabit both land and water, as also amphibia, with land animals that came there, or vegetables that were brought there, making a heterogeneous mixture. And I believe it may be observed in general, that the fossil bones of land-animals or birds are commonly found in such deposited materials, as gravel, sand, clay," etc.—P. xxxvii.

"But the preservation of vegetables and land-animals is most probably not confined to such situations alone. A change in the situation of the sea most probably has been a cause in the production of such fossils, which constitutes a third situation of the production of fossils. Therefore, to preserve vegetables, bones of land-animals, and many birds, one of two circumstances must have taken place: first, a change of the situation of the sea upon the land where such productions are. But in [regard to] what may be called 'land-birds,' there will be a few of them [found fossil]; for hardly any change in the land or sea can take place but what they can follow,—the new rising land, as it were, growing out of the waters, and abandoning the old, which now becomes covered with the waters."—P. xxxviii.

The tenor of the above observations may be contrasted with those made in Lyell's 'Principles of Geology,' on which the conclusions of modern geologists have been founded. Hunter, after hypothetically suggesting that some fossil species may be now extinct, says,—

"How they became extinct is not easily accounted for; for although we must suppose that the species of deer [*Megaceros*] to which belonged the bones and horns now found in the island of Great Britain, more particularly in Scotland, and still more in Ireland, is lost, yet we have reason to believe they were coeval with the elephant; for I have the lower jaw and tooth of an elephant that were dug up at Ougle [Oundle], in Northamptonshire, twelve feet below the surface, in a strong blue clay; and with it, one of the horns of the large deer."—P. viii.

This opinion of the antiquity of the *Megaceros* has been confirmed by later observations: in Ireland its remains occur in the shell-marl underlying the turbary.

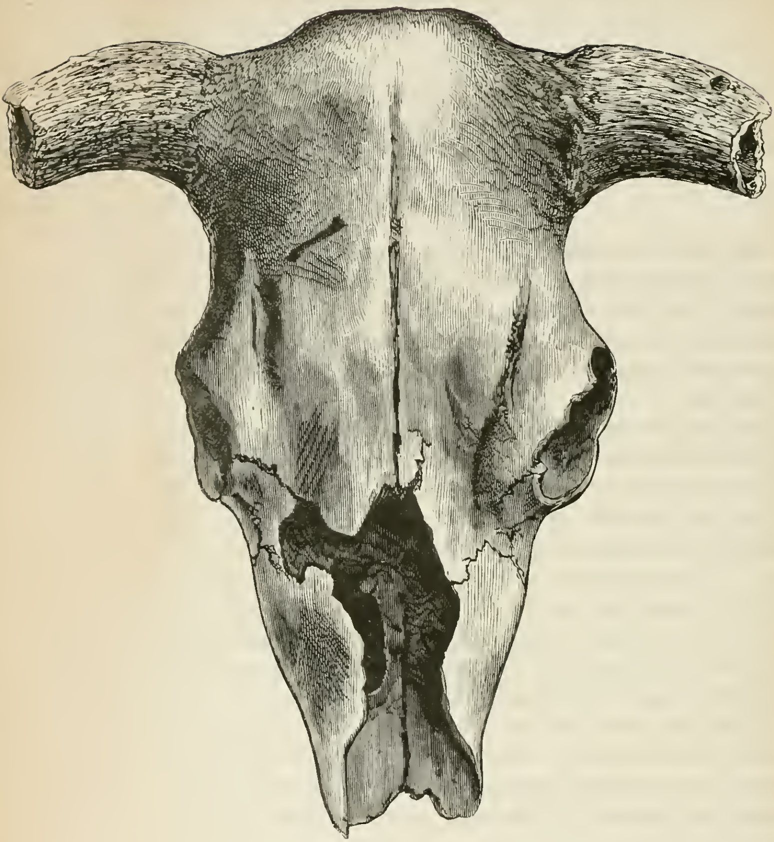
Hunter proceeds to express his thoughts on the nature of fossil organic remains, as follows:—"No definition can be given that will suit every fossil, except simply that which strikes the eye, which in a general way is pretty correct. For as extraneous fossils have been and can be matched by such substances in a recent state, and probably the animals most [frequently], they may in a general way be distinguished; and this arises from the part in a fossil state having been more or less deprived of the parts belonging to the recent, which is the animal part; and which is what principally gives colour to them: thus fossil shells have none of those bright colours found in the recent; yet some shells retain something of their original colour, though the animal part is dissolved into a kind of mucus, which would make us conceive that both the animal and earthy parts were so disposed as to reflect nearly the same colours, but the animal part is by much the brightest: for it is not simply the state in which the substance is that constitutes a fossil; but it is the state, with the mode in which it was brought to that state, that commonly constitutes a fossil; for many things might be called an 'extraneous fossil' if considered abstractedly from the manner of their being brought to that state; [and so considered] every churchyard would produce fossils."—P. xxiv.

"To establish the principles of fossils, I shall set it down first as a principle, that no animal substance can of itself constitute, or be turned into, a fossil; it can only be changed for a fossil." The acute distinction drawn between 'turned into' and 'changed for,'—a distinction which theologians and metaphysicians have long rightly drawn, but which many of our learners in palæontology find it hard to perceive,—was clearly present to the mind of John Hunter.

With respect to the other portions of the work before us, not immediately of a geological nature, extending over two thick octavo volumes, we must be silent. We must coincide with Professor Owen that the text "is here and there obscure enough to test the acumen of a skilled logician to decipher the sense. But it is always a matter of interest to endeavour to make out the meaning of a deep and original thinker; and different minds, unbiassed by any suggestion of the editor, may be induced to give their views of Hunter's meaning, and their opinions of his conclusions. It may be interesting also to some, standing on the vantage ground of seventy years' progress, to know what such a self-taught philosopher did not know on the subjects he grappled with: and a small proportion of the present writings of Hunter may chiefly serve to illustrate his mental peculiarities and shortcomings.

"To those who are conversant with Hunter's style, other testimony of the authenticity of the present writings will be superfluous: and it has seemed to the editor that the requirements of science would be best met by presenting these writings 'pure and simple,' as Hunter left them."

We have only to say that the sole qualified person in England to develope the thoughts of the great past English anatomist and palæontologist was the Biologist who had so long occupied the Hunterian chair at the Royal College of Surgeons, and who has so conscientiously and ably performed a difficult and laborious task in publishing the lost Hunterian manuscripts.



BOS FRONTOSUS (Nilsson).

From a Pleistocene deposit at Bawdsey Bog, near Felixstow, Suffolk.

In the National Collection, British Museum.

S. J. Mackie del.

THE GEOLOGIST.

DECEMBER 1862.

BOS FRONTOSUS.

By the side of a cast of the large-fronted ox of Scandinavia, in the case of fossil Bovidæ in the British Museum, is a specimen found in Bawdsey Bog, near Felixstow, in Suffolk, referred to that same species —the only example recorded in England, if exhibition in the cases of our national institution be a record, for it has been nowhere figured or described.

That the determination of the species is correct there can be little doubt, as the specimen was seen and examined by Professor Nilsson on his late visit to this country, and the correctness of the determination was verified by him. It is to this, one of the most interesting but least known species, that we now wish to draw attention. It is interesting because it was probably a species of higher antiquity that lived on to be coæval with the early human races whose relics are found in the deposits of that remarkable border-land between the last geological ages of the Prehuman era and the obliterated first chapters of Human History.

In the ages which elapsed immediately previous to the deposition of the glacial drift, and subsequently to that period, extending down even to the modern historical era, seven species of fossil Bovidæ ranged the pastures of England, as will be more clearly seen in the annexed table:—

Distribution of Bovidæ in Great Britain.	Pliocene Fresh-water.	Post-pliocene Marl.	Glacial Drift.	Cave Deposits.	Historical Period.
Bos giganteus s. antiquus, *Owen*	×	...	...	...	...
Bos primigenius, *Bojanus*	...	×	...	...	?
Bos frontosus, *Nilsson*	...	×	...	...	...
Bos longifrons, *Owen*	...	×	...	...	×
Bison priscus, *Owen*	×	...	...	...	...
Bison minor, *Owen*	...	...	...	×	...
Bubalus moschatus, *Owen*	...	...	×	...	...

The species *Bos frontosus* was founded by Nilsson, and is characterized by the great size, length, and breadth of the forehead, and the prominent elevation between the horns, somewhat similar to that in the subgenus *Bibos*, or the Gours, Gayals, and Bantingers of Southern Asia. Its superiority of size, and the general robustness of the structure, sufficiently differentiate it from *Bos longifrons;* whilst the direction of the horns, which curve moderately downwards, and the general proportions of the forehead, prevent confusion with *Bos primigenius* or *Bos giganteus.*

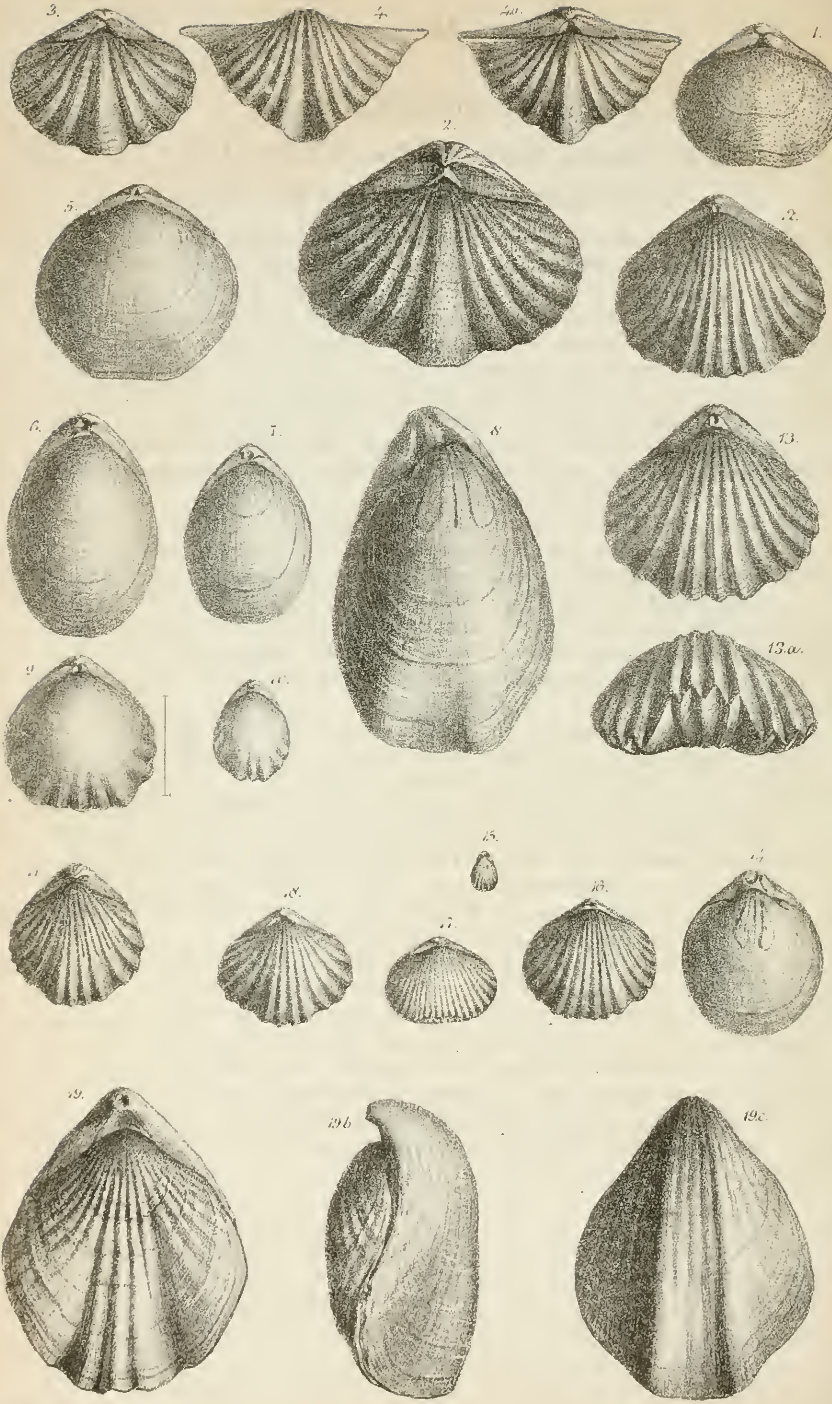
Comparison of the specimen with the cast of the typical *Bos frontosus* presented by Professor Nilsson, indicates some minor points of difference. Thus, Mr. Davies points out that the space between the orbits and the attachment of the horn-cores is much longer in the cast than in the Suffolk specimen. The elevation between the horns is also higher, and the breadth between the orbits greater in the cast.

In Switzerland, at the present day, a small and spotted variety of ox is found, which M. Rütimeyer considers to be descended from the *Bos frontosus.* We are not aware that any one has yet worked out the points of distinction between the existing breeds of oxen in England and Scandinavia, and the gigantic large-fronted ox whose remains have been figured by Nilsson; but the first British specimen is that of which we give a portrait in Plate XV.

Our impression, however, is that a closer inspection of the semi-fossilized, or rather unfossilized remains of Bovidæ, which are so commonly turned up in the superficial deposits all over England, and which are now heedlessly neglected, will be found to yield more specimens of this noble ox.

The gigantic ox which was found in the Hercynian forests of Germany, of whom Cæsar speaks (De Bello Gallico, lib. 6. xxvii.): "Tertium est genus eorum, qui Uri appellantur. Ii sunt magnitudine paullo infra Elephantos, specie et colore et figura tauri. . . . Amplitudo cornuum et figura et species multum à nostrorum boum cornibus differt," has been generally considered to be *Bos primigenius.* It may possibly be so; but Cæsar, who was accustomed to the long-horned oxen of the Romagna, would hardly have noticed a difference between them and the equally long-horned *primigenius.* The difference, however, between the horns of *B. frontosus* and the Italian ox would have struck him at once.

It would not be fair of me to close this paper without acknowledging that my attention was directed to this specimen by my friend Mr. Carter Blake.



T Davidson, del. et lith.

Vincent Brooks, Imp.

PALÆONTOLOGICAL NOTES.

By Thomas Davidson, Esq., F.R.S., F.G.S.

I. ON SCOTTISH JURASSIC BRACHIOPODA.

So little is known of Scottish Jurassic Brachiopoda, that any additional information cannot fail to prove interesting. Professor Nicol wrote me on the 16th of April, 1860, that out of a pretty large collection of the fossils of this period sent up to the Aberdeen meeting of the British Association, he found only two species and specimens of Brachiopoda, and both imperfect. That in Sunderland they are most common in the Dunrobin Reefs (by some thought to be Oxford clay, by others Lias), but that the stone is so friable, that the specimens fall to pieces almost at the slightest touch; and that in the sandstone at Braambury Hill, are casts of a large shell, like *Terebratula perovalis*, but often crushed and distorted.

In 1850, the late A. Robertson, of Elgin, sent me two beautifully preserved *Rhynchonellæ* (*R. lacunosa?*), from Dunrobin, and which will be found figured and described in my monograph; and about the same period, the late Hugh Miller sent me a specimen of *T. numismalis*, from the Lias of Shendwick, and another of *Rhynchonella Bouchardii*, from the Lias of Cromarty. Mr. Geikie recorded likewise a *Rhynchonella tetrahedra*, from the Middle Lias of the island of Pabba.

It would result from the above statement, that about six species of Brachiopoda have, up to the present period, been mentioned as having been found in Scottish Jurassic strata.

On the 9th of April, 1860, Captain E. J. Bedford, R.N., informed me that while surveying the island of Mull, he discovered a great number of fossils in the Middle Lias of Caisaig Bay; these he kindly forwarded for my examination, and I found among many other Mollusca, eight or nine species of Brachiopoda, two of which being new to Scotland, and one even so to Great Britain.

I was informed, at the same time, that these fossils had been all cut out of a hardened kind of black clay, uncovered at low water; that this clay lay in laminæ, which he lifted up with a little bar, and in which he found all the specimens sent up, with the exception of *Terebratula punctata* and some other species of Mollusca, which he obtained from hard masses of limestone scattered about the shore.

The following is a list of the Mollusca from the Middle Lias of the island of Mull, which Mr. Etheridge and myself were able to determine:—

Terebratula punctata.	Rhynchonella rimosa.
Waldheimia numismalis.	Rhynchonella variabilis.
Spiriferina rostrata.	Rhynchonella (another species?).
Spiriferina Walcotti.	Ostrea?
Spiriferina oxyptera.	Avicula inæquivalvis.
Rhynchonella tetrahedra.	Modiola Hillana.

Lima Hermannia.
Plicatula spinosa.
Lima acuticosta.
Pecten priscus.
Pecten vellatus.
Gryphæa cymbium.
Gryphæa obliqua.
Pholadomya ambigua.
Pholadomya decorata.
Cardium cucullatum (Opis).
Pleuromya scotica.
Pleuromya unionides.
Lima acuticosta.
Hippopodium ponderosum (young).
Unicardium cardioides.
Gresslya anglica.
Arca truncata.
Arca Buchmanni.
Arca elongata.
Leda rostralis.
Astarte Psilonoti ?
Modiola scalprum.
Pinna folium.
Pinna tetragona.
Trochus anglicus.
Pleurotomaria ?
Ammonites raricostatus.
Ammonites Jamesonii.
Belemnites lævigata, *var.* clavatus.

Since the discovery of the above-named fossils by Captain Bedford, Mr. J. Thomson, of Glasgow, has visited the island of Pabba, where he found *T. punctata*, *Sp. Walcotti*, *Rh. tetrahedra*, and another species, which I was unable to determine. He also found in the Bay of Lussay, four miles from Bradford, in the island of Skye, some examples of *Sp. Walcotti*.

Scottish Jurassic Brachiopoda.

1. Spiriferina rostrata, *Schloth. sp.* 1822, *pl.* xxiv. *fig.* 1; *Dav. Mon. p.* 20, *pl.* 2, *figs.* 1–21; *pl.* 3, *fig.* 1. Of this species, Captain Bedford found one perfectly characterized specimen in the Bay of Caisaig, Mull.

2. Spiriferina Walcotti, *Sow.* 1823, *pl.* xxiv. *figs.* 2, 3; *Dav. Mon. p.* 25, *pl.* 3, *figs.* 2, 3.

This is a common form in Scottish liassic deposits, although rarely found perfect. It was found by Captain Bedford in the Bay of Caisaig, Mull. Mr. J. Thomson obtained it was also from the Middle Lias in the Bay of Lussay, four miles from Bradford, in the island of Skye, and again, from the island of Pabba. It varies considerably in size and in the number of its ribs, but is entirely similar to those found in England.

3. Spiriferina oxyptera, *Buv.* 1843, *pl.* xxiv. *fig.* 4. Spirifer oxypterus (*Buvignier*), *Mém. de la Soc. Philom. de Verdun, tom.* ii. *p.* 14, *pl.* 8, *fig.* 8; *Géol. des Ardennes, p.* 534, *pl.* 5, *fig.* 5; *Dav. Annals and Mag. of Nat. Hist.* lii. *p.* 264, *pl.* 15, *figs.* 5, 6, 7, 1852.

Shell variable in shape, transverse and obscurely subrhomboidal; valves convex; beak more or less produced and incurved; hinge-line as long as the greatest width of the shell; cardinal angles tapering into acute points; area subtriangular and of moderate width; fissure partly arched over by a pseudo-deltidium. In the dorsal valve the mesial fold is formed of a single rib, to which corresponds a sinus in the ventral one. Each valve is, in addition, ornamented with from eight to twelve simple ribs, and the surface, besides being punctured, is covered with delicate spines. Dimensions variable. Our Scottish example measured nine lines in length by sixteen in width.

This species is here mentioned for the first time as a British fossil, and was discovered by Captain Bedford in the Bay of Caisaig, island of Mull. The Scottish specimen above described, agrees otherwise with M. Buvignier's type.

4. Terebratula punctata, *Sow.* 1843, *pl.* xxiv. *figs.* 6, 7; *Dav. Mon. p.* 45, *pl.* 6, *figs.* 1–6.

This is a common shell in the Middle Lias of the Bay of Caisaig, island of Mull, where it has been collected by Captain Bedford; Mr. J. Thomson found it in the island of Pabba; and Professor Nicol states to have found it near Dunrobin. The Scottish specimens are exactly similar to those which occur in England.

5. TEREBRATULA PEROVALIS, *Sow.* 1825, *pl.* XXIV. *fig.* 8; *Dav. Mon. p.* 51, *pl.* 10, *figs.* 1–6.

Specimens agreeing with our English example have been found by Professor Nicol, in the Inferior Oolite of Braambury Hill, Brora. The specimen here figured belongs to Marischal College, Aberdeen. Other examples have been procured near Elgin, by the Rev. J. Morrison.

6. WALDHEIMIA NUMISMALIS, *Lamarck*, 1819, *pl.* XXIV. *fig.* 5; *Dav. Mon. p.* 36, *pl.* 5. *figs.* 4–9.

Specimens exactly similar to those we find in the Middle Lias of England, have been collected in the Bay of Caisaig, by Captain Bedford. It was also found by the late Hugh Miller, in the Lias of Sheudwick, in Scotland.

7. RHYNCHONELLA TETRAHEDRA, *Sow. sp.* 1812, *pl.* XXIV. *fig.* 12; *Dav. Mon. p.* 93, *pl.* 18, *figs.* 5–10.

This species is common in the Middle Lias of the Bay of Caisaig, where it has been found by Captain Bedford. Mr. Geikie found it, and Mr. J. Thomson obtained it from the island of Pabba, and from whence it is alluded to by Dr. Wright, in his notes on the fossils collected by Mr. Geikie from the Lias of the isles of Pabba, Scalpa, and Skye. Proc. of the Geol. Soc. vol. xiv. p. 26, 1808.

8. RHYNCHONELLA BOUCHARDII, *Dav.* 1852, *pl.* XXIV. *fig.* 9; *Dav. Mon. p.* 82, *pl.* 15, *figs.* 3–5.

This species was found by the late Hugh Miller in the Lias of Cromarty, and agrees exactly with those found near Ilminster, in England.

9. RHYNCHONELLA RIMOSA, *De Buch.* 1843, *pl.* XXIV. *fig.* 11; *Dav. Mon. p.* 70, *pl.* 14, *fig.* 6.

Specimens agreeing in every particular with those of England have been found by Captain Bedford in the Middle Lias of the Bay of Caisaig. It has also been found in the island of Pabba, by Mr. J. Thomson.

10. RHYNCHONELLA VARIABILIS, *Schloth*, 1813, *pl.* XXIV. *fig.* 10; *Dav. Mon. p.* 78, *pl.* 16, *fig.* 5.

One of two small specimens, agreeing with some English individuals of this variable species, have been found by Captain Bedford, in the Middle Lias of the Bay of Caisaig, and by Mr. Nicol, at Loch Aline, Sound of Mull.

11. RHYNCHONELLA LACUNOSA, *Schloth ?* 1813, *pl.* XXIV. *fig.* 13; *Dav. Mon. p.* 96, *pl.* 16, *figs.* 13, 14.

Several specimens were obtained by the late Mr. Robertson, in Oxford clay ? (perhaps Lias ?), at Dunrobin.

In addition to these, eleven undeterminable fragments of another *Rhynchonella* were found by Captain Bedford, in the Bay of Caisaig.

Such is the scanty information I am able to communicate with reference to Scottish Jurassic Brachiopoda, and I should feel much obliged to any Scottish geologist who could forward to me any additional information.

II. SCOTTISH CRETACEOUS BRACHIOPODA.

For some years past I have endeavoured, with but very indifferent success, to assemble data concerning the cretaceous Brachiopoda of Scotland.

Mr. W. Ferguson, F.G.S., noticed the occurrence of chalk-flints and greensand in Aberdeenshire, Proc. Glasgow Phil. Soc. iii. p. 33, 1849, and in the Phil. Mag., May, 1850. Mr. Salter subsequently referred to the same subject in the twelfth volume of the Quarterly Journal of the Geol. Soc. p. 390, 1856, and in the same work for 1857; and we find that the following four species are recorded as having been found in Scotland :—*Crania striata*, *Kingena lima*, *Rh. Mantelliana*, *Rh. compressa.* I have not however been able to examine specimens of these species. Having communicated with Professor Nicol upon the subject, he kindly forwarded for my inspection specimens of four others, which had been found by Mr. Murray, of Aberdeen, viz. :—

1. Terebratulina carnea, *Sow.*, *pl.* xxiv. *fig.* 14.

Internal flint-casts in flint nodules, from Curden, Aberdeenshire.

2. Terebratulina striata, *Wahlenb.*, *pl.* xxiv. *fig.* 15.

Also in flint-casts, same locality.

3. Rhynchonella plicatilis and R. octoplicata, *Sow.*, *pl. figs.* 16, 17, from the same locality.

There were also some one or two other forms, which were not sufficiently well preserved to admit of a correct determination. One of these belongs probably to *Rh. Cuvieri.*

4. Rhynchonella . . . . ? *pl.* xxiv. *fig.* 18.

I could not determine this *Rhynchonella* which had been found by Mr. R. Dawson, in Upper Greensand, at Curden, Aberdeenshire. Professor Nicol informs me that the Greensand fossils are mostly found in the state of casts, and not often preserved well enough to admit of a correct determination.

III. TERTIARY BRACHIOPODA.

Brachiopoda do not appear to have been specifically as numerous during the Tertiary period as they were in the older formations, and it has been observed that the species of the first-named period are in many instances specifically identical with those still in existence.

Three or four years ago, Mr. Etheridge gave me a Terebratula he had received from the island of Malta, assuring me at the same time that it had been obtained from Miocene or Pliocene deposits of that island. This shell struck me at the time as very remarkable, and this impression was subsequently concurred in by Professor Suess, to whom I showed it when he was last in England; I may also mention that while looking at some Tertiary fossils from Victoria, at the International Exhibition, I observed a Pliocene *Terebratula*, which, if not specifically identical with the Maltese species, is at any rate a very nearly related form.

Waldheimia Garibaldiana, *Dav. n. sp. pl.* xxiv. *fig.* 19.

Shell somewhat obscurely pentagonal. Ventral valve convex and rather deep, divided into three portions by two diverging ridges or ribs, which commence close to the extremity of the beak, and extend to the front, leaving between them a slightly concave or flattened space, in which three or four longitudinal ribs are observable. The lateral portions of the valve become gradually and gently concave as they approach the margin, and are obscurely marked by a few longitudinal ribs. The beak is somewhat produced, incurved, and truncated by a small foraminal aperture, which is separated to some extent from the hinge-line by a deltidium. The dorsal valve is not nearly as convex as the ventral one, and is likewise divided into three portions, the central one being flattened and furrowed by four longitudinal ribs, while the lateral portions become more elevated as they approach the front, and curve inwards so as to meet the valve-edges of the central lower portion of the valve.

Upon each of the lateral portions of the valve may be observed six or seven ribs, which become somewhat obscured as they approach the margin of the shell. Interior unknown.

Length, 1 inch 7 lines; width, 1 inch 3 lines; depth, 10 lines. Tertiary, Malta.

Obs. The recent species to which this shell bears the closest resemblance is the *Waldheimia flavescens*, Lamarck, now alive in myriads at Port Jackson, Australia, as well as in some other localities. The recent species is however more regularly ovate than is the fossil one, the beak is less elongated, and with a larger foraminal aperture.

THE GEOLOGY OF MAIDSTONE.

By W. H. Bensted, Esq.

(*Concluded from page* 382.)

There only remains now to notice the post-Tertiary deposits to complete this account of the geology of Maidstone. The surface-soil and the earth filling in and covering over the faults and large fissures consist of clay, gravel, "sharp" drift-sand, and fine sand, all being sedimentary deposits from water under different rates of motion. The exteriors of the highest masses of rock show the effects of a powerful erosion continued for a long period of time; but this action was not the dashing of billows, for some surfaces of the rock, although worn to a great extent, have portions of fragile shells standing out from their surfaces, just as in the cavernous gutters of the rock masses of spiculæ jut out from the walls, the loose sand or soft hassock having been washed away.

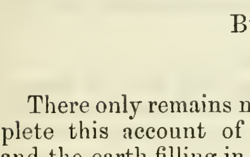


Fig. 9.—Protrusion of Ragstone into Drift, at Maidstone. *a*, beds of Ragstone; *b b*, drift; *c c c c*, clay; *d d*, line of flints.

Old watercourses exist at a considerable depth from the surface, showing that a gradual lowering of the water-level of the springs has taken place.

The opinion I have formed respecting the beds of drift and sedimentary clays, which in the district are found between the masses of rock, is that an elevating force has lifted these masses, bearing up the drift and clay (Fig. 9), and that, in some instances, the peaks of the smaller masses of rock have been protruded into the drift and clay, piercing and dividing them into lines at angles parallel with their sides.

The phenomena of these deposits offer a wide scope for consideration. The causes of such an accumulation of sedimentary matter, the deposit of such matter anterior to the clay, and the water-worn faces of the bluffs, could not have occurred in the present state of the surrounding country. The rush of water necessary for such events must have had a source much greater than any now existing in the district, and perhaps far distant. The quantity of water must have been vast. The conjecture that England at one time joined the continent, and that the mountains of the continent were the sources from which the supply proceeded, is therefore probable. It is very interesting to find that the waters of the Medway deposit now a sediment very similar to the clay filling up the faults and covering the highest parts of the rocks. The larger débris brought down by the river is also analogous to the gravel. I am thus led to the inference that these deposits are the relics of water having considerable motive power.

The principal sources of the Medway are now in the elevated portions of the Weald, but we cannot attribute the ancient "diluvial" waters to so limited a source.

The lines of fracture, which constitute the principal faults, are parallel to the course of the Medway, and are filled almost entirely with clay (brick-earth), and contain the remains of mammalia, viz. elephant, deer, horse, and hippopotamus. The bones and teeth are found at a considerable depth in the clay, and much separated. I discovered a fragment of a jaw of a horse with five teeth in their sockets. There occurs also, at a depth varying from ten to twenty feet from the surface, a bed of freshwater shells, *Lymnæa*, *Helix*, and *Pupa*. These shells are rather sparingly distributed, but may be found in all the clay-pits worked on each side of the river. The general level of the bed is about a hundred feet above the present level of the water. Transverse faults cross the main lines of fracture, and these are filled with a gravelly drift of flints, chert, and ragstone, more or less water-worn ferruginous sand, and occasionally a boulder of Druid sandstone. In the gravelly detritus I have found detached fossils from the Lower Greensand.

The following statement of the moving power of water, in the 'Civil Engineers' and Architects' Journal,' gives the rates of the force required for the disturbance of matter subjected to its action:—"A velocity of three inches per second at bottom will work upon fine clay; six inches will lift fine sand; eight inches per second, sand as coarse as linseed; twelve inches per second will sweep along fine gravel; and twenty-four inches per second, gravel one inch in diameter." From the above facts it would appear that the clay, drift-gravel, etc., were not deposited by the same forces, and consequently not at the same time. The red clay, composed of very fine particles, was deposited after the erosion of the rock. At that period, I presume, a great flow of water was wearing away the angles of those rocks which obstructed its course. When this speed diminished and the water became tranquil, the fine clay held in suspension deposited itself at the bottom; this process continuing for a very long period of time, as the depth of this clay is, in the highest faults, from eighty feet upwards. The transverse faults were filled also with the same clay, but we now find them occupied by drift-gravel from half an inch to three inches in diameter. Another epoch, I imagine, then occurred, when a force of water swept out the fine clay in the transverse faults, and deposited the drift in its place. This had its subsequent subsidence into the fissure or fault. A third period then took place, during which the land-surface was reduced to its present form; some of the faults were hollowed out, others left undisturbed. The undisturbed faults show no indication on the present surface of the subsidence of materials which has taken place within their walls, and this proves that the beds of clay were at one time much higher than they are now. We find a clay similar in many respects to this, lying upon the highest summits of the chalk-hills, and at an elevation of 200 feet above the ragstone on which this lower clay reposes; but this upper clay contains chalk-flints not worn by attrition, and immense boulders of "Druid sandstone." I have never found any fragments of ragstone in these upper beds of clay, which run up to the very verge of the chalk escarpment. At page 301 I have observed that in some situations no indication is seen at the surface of the land of the fault below, although this may be afterwards exposed in digging for stone; and when a section is thus made, a great subsidence is seen to have taken place, as indicated by bending lines at *d d d* in the diagram.

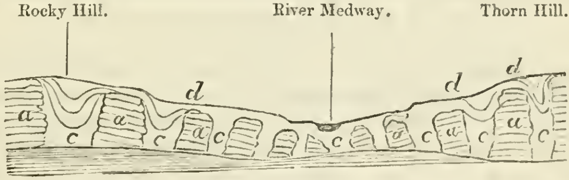


Fig. 10.—Section of the beds of Ragstone from E. to W., Maidstone.

a a represents the beds or cliffs of ragstone. *c c*, faults filled with red clay. *d*, divisions of beds of fuller's earth, gravel and sand, clay, etc., showing the lines of subsidence and of lateral pressure of the masses.

The "Druid sandstone," of which rock Kits Coty house, Stonehenge, and many other Druidical remains are composed, is found scattered in great blocks over the surface of the chalk-hills, or buried superficially in the beds of clay retained in the hollows on the summits of the escarpments.

These blocks or boulders of siliceous sandstone are composed of granular quartz, and occasionally envelope chalk-flints and other extraneous bodies; they are perfectly analogous to those found in Berkshire and Wiltshire, where they are distinguished by the title of "grey wethers." Dr. Mantell, in his 'Geology of the South-East of England,' speaks of the "beautiful conglomerate or pudding-stone of Hertfordshire. I have occasionally found fragments of a similar conglomerate on the Maidstone hills, near the sites of the 'grey wethers.'"

The statement of the late Dr. Mantell still holds good, that "no regular stratum of the 'Druid sandstone' has yet been discovered in this country, and its geological position is still undetermined."

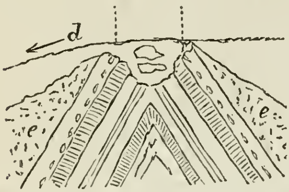


Fig. 11.—Anticlinal at Preston Quarry. *a a*, black greys; *b b*, molluskite bed; *c c*, loamy clay and greensand, with beds of stone bored with lithodomi at *c′ c′*; *d*, surface falling to the Medway.

Preston Quarry, on the south side of the Medway, offers a fine section of the effects of an elevating force, as may be seen in the accompanying sketch (fig. 11). The stone is fractured in all directions, and consequently large blocks are not obtainable. The diagram, fig. 12, gives the continuation of the disturbed beds.

The most interesting part of the quarry is the bed of loamy clay, *c c*. It is about three feet in thickness, and contains fragments of shells—oysters, terebratulæ, corals, etc. In detached pieces, with their edges rounded, is a layer of stones, varying in thickness of about 2 inches by 6 or

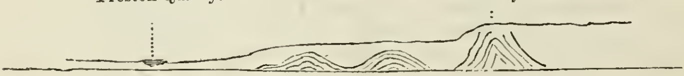


Fig. 12. Section of Preston District.

12 inches across. Their upper surfaces (*c′ c′*) are perforated by lithodomi, and the perforations are filled with the loam and a white powdery deposit. The excavations are about 2 inches in depth; and one fragment is so perforated, that not a square inch of it remains intact.

CORRESPONDENCE.

Origin of Flint in Chalk.

Dear Sir,—Flint in chalk is found as bands of nodules or thin seams separated from each other by intervals of chalk varying from a few feet to many yards; the nodules, from a boy's marble to two or three feet in diameter. In some pits only solitary flints occur here and there; in others, in the same upper flint-bearing chalk, there are no flints at all.

We have terebratulæ composed of pure flint extracted from blocks of equally pure chalk.

I consider it very doubtful whether the flints have been deposited successively with the beds of chalk. Flint nodules, it appears to me, are actually in process of increase at this day. Yours truly,

Robt. Mortimer.

Fimber, Malton, November 13th, 1862.

Restoration of Pteraspis.

My dear Sir,—I have read the Rev. H. Mitchell's paper on "The Restoration of Pteraspis" with great interest, but the conclusions he draws from his Scotch specimens are, I think, by no means borne out by examples obtained from English localities. I enclose you two sketches of Pteraspids from Cradley, in Herefordshire: one, in my own collection, showing the anterior portion of the shield; the other, exhibiting the posterior portion and surface markings, in the possession of Mr. Gregory, of Golden Square. These two sketches will be sufficient to show that the shield, as drawn by Mr. Mitchell, is wanting in some important particulars; the true form I believe to be that given in fig. 3. Mr. Mitchell seems to be under the impression that the restoration of Pteraspis has never before been attempted, although first-rate specimens have been in our museums and private collections for some years. Professor Huxley, in vol. xvii. of Geol. Soc. Journal, has given a diagram of a restored Pteraspis, which is copied in fig. 3; he has likewise referred to the subject in British Association Reports, 1858, and has further written a detailed account of the microscopic structure of the test in vol. xiv. of the Journal. The references in fig. 3 are as follows:—*a* is the snout or rostrum, united with *b*, the shield-like disk; *c c* are the lateral cornua attached to the disk; *e* is the posterior spine, and *f f* are the orbits or perhaps the nasal apertures. The corresponding parts can be easily found in the sketches I have given of the fossil Pteraspids. I may just mention here, that the bonelike test of these fish is composed of three layers,—an external, finely striated layer, a middle cancellated layer composed of polygonal cells, and a third internal layer of a laminated nacreous substance. The specimen drawn in fig. 2 shows the external layer remarkably well; in fig. 1, parts of the middle cancellated layer may be seen; the rest of the test, which is preserved, being the internal nacreous layer.

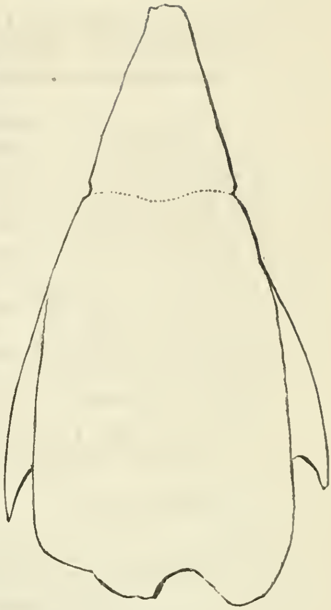


Fig. 1.

I remain, dear Sir, yours truly,

E. R. Lankester.

8, *Savile Row, Nov.* 9.

P.S.—You will observe some minute indentations drawn in fig. 2, on the surface

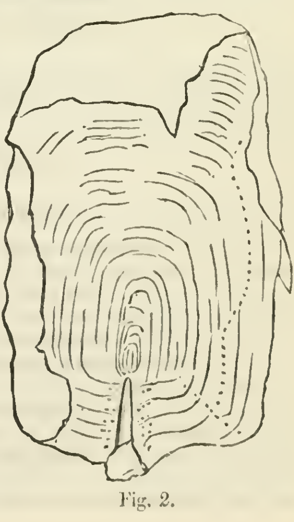


Fig. 2.

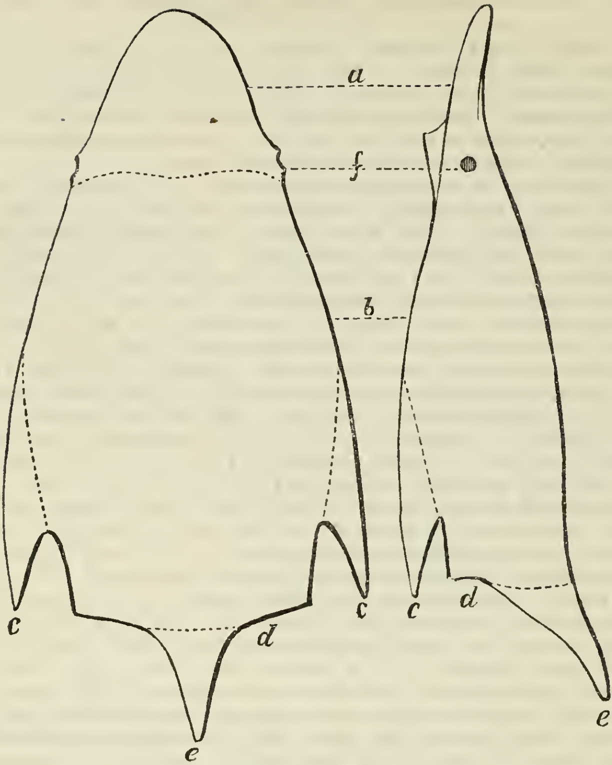


Fig. 3.—Diagram of restored Pteraspis.

of the shield. Professor Huxley informs me that he believes them to be the sites (if I may so say) of mucous follicles. I have thought this worth mentioning in a note, as they have never before been noticed.

When and how was the Isle of Wight severed from the Mainland?

Sir,—On two different occasions inquiries have been made in the pages of the 'Geolegist,' as to the period at which the Isle of Wight was torn from the mainland and entrusted to the rude guardianship of the ocean. The subject is an interesting one, especially in its geological aspects; and as I have given some attention to it, I will attempt to reply to the inquiries of your Lymington correspondent.

I am not aware that there is the least particle of historical evidence that gives countenance to the famous passage in Diodorus Siculus that has been interpreted by various writers as proving that, when he lived, the channel of the Solent was fordable at low water. As the particular island of which Diodorus is speaking, was one from which the miners of Cornwall were in the habit of exporting their minerals, and there is a small isle (St.

Michael's) on their own coast, to which such minerals could easily have been conveyed, and which, in its connection with the mainland, answers pretty closely to the historian's remarks; and further, as I know of no argument worth listening to why the miners of Cornwall should have transported their tin to the Isle of Wight for exportation,—on all these several grounds, I think one may safely conclude that neither Diodorus, nor any other writer of note, has left any evidencv whatsoever about the fordableness of the Solent within historical times.

The severance of this island from the mainland, it appears to me, was effected under very unusual circumstances, and at a very distant period. The present channel of the Solent, being pretty nearly equally deep and equally broad throughout its entire length of twelve or fourteen miles, proves at once that it was not formed in the usual way of island-severing channels, that is, by gradual encroachments of the sea on the two opposite sides of a narrow neck of land. If so formed, the middle part of the channel would naturally have been both narrower and shallower than the two mouths that first admitted the tide towards it; but this is not the case. Nor are there any important indestructible obstructing rocks on either side of the channel that could account for this peculiar formation. It is to be accounted for, therefore, not by the excavations of a gradually approaching sea, but, as I shall hereafter have to attempt to show, by its being originally the trunk or outlet of a very considerable river.

Again, at the western mouth of the Solent, there is almost an immeasurable accumulation of rolled flints, with which are mingled a sufficient sprinkling of fragmental fossil shells of various genera and species to show us from whence the whole mass was originally transported. This accumulation forms a sort of natural breakwater, two miles in length, one hundred yards in breadth, and many feet in thickness, extending between the mainland at Milford and a point beyond midchannel, where Hurst Castle was erected three centuries ago. Where the castle stands, this bank of flints becomes expanded so as to cover a circular space of fully twenty acres. Now all this enormous accumulation of flints, together with another one probably much larger on the island side of the main channel, and lying under the sea, in front of Alum Bay and the Needles, are formed of drift and broken fossils from the Barton beds; the fossils themselves plainly pointing to the formation whence the whole mass was derived. It would add too much to the length of my paper, to account for this vast lodgment of drift around the mouth of the Solent; neither is this needful as respects the objects of my remarks: only I would have my readers to understand that it depends upon the flow of tide through the channel of the Solent. And when it is remembered that the annual supply of drift along the Barton cliffs is comparatively small, it will then be seen that it must have required a period reaching far back in time to gather together the vast accumulations referred to above, and consequently they may be regarded in themselves as visible and lasting memorials of the very great antiquity of the separation of the Isle of Wight from the mainland.

Nay, I will venture to hazard an opinion, even though I stand without geological authorities to support me, that will place the date of the formation of the Solent Sea still further back in the dimness of the past; an opinion to which both the peculiarities of the channel itself above referred to, and the geological formation of the surrounding country, bear very strong testimony. Whoever as a geologist examines the vertical strata of the chalk at the Needles, nay, and throughout the whole length of the Isle of Wight, and the strata of the same rock in exactly the same unusual position on the bold white cliff on the Dorsetshire coast some twenty miles westward of the Needles, will not doubt but that the two promontories were once united, forming a rocky neck of land from Dorset to the Needles. This chain of chalk might, or might not, be so cleft in twain as to allow the rivers of Dorset and Wilts. to find a passage through them to the main ocean. My opinion, however, is that they had no such outlet, but that, at that far distant period, the entire drainage of more than two counties, embracing the rivers that join the sea at Poole and Christchurch, flowed through what is now called Christchurch Bay, down the Solent, and joined the sea at Spithead.

According to this theory, the Solent was at that time an estuary somewhat like the Southampton Water, having but one opening to the British Channel; but of so much more importance than the latter as it was fed by a vastly greater flow of fresh water; and it further supposes that the bed of the Solent was scooped out originally by a river, which from the extent of its drainage one may guess to have been little inferior to the Thames or the Humber. And this opinion acquires countenance from the circumstance that it accounts, in a most satisfactory way, for the equality of depth and breadth in the Solent Sea. Of course, according to this view, this sea would lose its original condition as an estuary at the time when the British Channel had so far made a breach through the chain of rocks connecting the Isle of Wight with Dorsetshire as to give an opening into itself for the Dorsetshire rivers, somewhere opposite to the town of Christchurch. From that time forth the Solent would become what it is at present, losing its character as an estuary, and assuming that of a long narrow sea. And at the same period, of course, the Isle of Wight would part with its peninsular character, and be severed from the mainland, but at a point far apart from that at which the severance is usually supposed to have taken place. The distant period at which such changes took place it would be hopeless to guess at, amid the dimness of the data on which calculations could be founded. It could not be less, however, than many thousands of years, seeing that since that time, the British Channel has not only made a broad breach of twenty miles through a chain of slowly yielding rocks, but has also pushed its way gradually across the broad extent of the Poole and Christchurch Bays.

In conclusion, I would observe, that if your correspondent at Lymington simply put his question about the separation of the Isle of Wight as an archæological inquiry, I fear he will consider my answer to it as somewhat dreamy. But I am confident, if he and others who may honour me with a careful perusal of my observations, are tolerably acquainted with the geology of the neighbourhood, and have had their minds disciplined for realizing the operations of nature on a large scale and through lengthened periods of time, they will perceive in this paper opinions indicative of more than novelty, having, as I believe, very important geological facts to uphold them. Yours, etc.,

W. Fox.

Brixton, Isle of Wight, Nov. 8.

Tracks, Trails, and Imprints.

Dear Sir,—At nearly the same time, probably, when I was pointing out the desirability of careful drawings and casts being made of the tracks and trails of living annelids, mollusks, insects, etc. ('Geologist,' No. 52, p. 138, April, 1862), for the guidance of the palæontologist in deciphering fossil surface-markings, my friend Dr. J. W. Dawson, of Montreal, must have been engaged in the useful labour of preserving faithful records of the track-marks of *Limulus polyphemus* on the sands of Orchard Beach (Gulf of St. Lawrence), for the purpose of comparing them with the fossil tracks, termed *Protichnites* and *Climactichnites*, found in the Potsdam sandstone of Canada.

The results of these well-directed researches have been described and illustrated by Dr. Dawson in the Canadian 'Naturalist and Geologist' for August, 1862 (vol. vii. No. 4), p. 271, etc.; and it appears certain that the trail of *Limulus* on wet sand is very similar to *Protichnites*, excepting that the latter has not the lateral furrows that are produced in the former by the edges of the carapace. Swimming in very shallow water, *Limulus* produces on the sand a trail very similar to *Climactichnites;* the latter, however, showing lateral and median ridges, whilst the former has furrows instead.

Dr. Dawson agrees, therefore, with Professor Owen in referring the *Protichnites* to a Limuloid animal; and is strongly inclined to refer *Climactichnites* to the same agent. Still he thinks it not impossible that the large Lower Silurian Trilobite, *Paradoxides*, may have been the animal that produced all the marks in question.

With the fact before him, that Climactichnital markings are left on a subaquatic *surface* by *Limulus*, Dr. Dawson, of course, rejects the hypothesis of *Climactichnites* being gallery-tracks, as advanced in my paper above referred to (*loc. cit.* p. 139). Still these recent tracks differ from what Dr. Dawson regards as their primæval analogues, in that their "lateral and medial lines are furrows instead of ridges;" and therefore the identification is not complete. I would ask that the question still remain open until Dr. Dawson and other good naturalists have more material at hand and a wider basis for conclusions.

"I may add that the burrowing of *Limulus polyphemus*," Dr. Dawson remarks, "is easily effected in soft sand, but is confined to a mere burying of itself beneath a very slight smooth elevation." The great well-known North American Trilobites (*Paradoxides*), however, whose bodies exactly fit in width to the Climactichnital and Protichnital trails of Canada, and whose abiding place was really the muddy sea-bed on the geological horizon of the Potsdam sandstone, in all probability crawled over these littoral sands, just as the *Limulus* frequents the existing sandy beaches in spring and summer; and (like *Sulcator* and *Kræyera*, *loc. cit.* pp. 131, 138, 139) it may have burrowed in them, with much longer burrows than *Limulus* makes, and in that case the in-fallen galleries would supply the raised ridges of the Climactichnite.

We need not suppose the presence of *Limulus*, or of any unknown Limuloid animal, in the primordial sea; for there is little doubt, if any, that *Paradoxides*, known to have then existed, can have made the trails in question (as Dr. Dawson allows, p. 277), if they had the usual crustacean locomotive apparatus; and "it seems almost certain, from analogy, that they must have possessed such organs" (Dawson, *loc. cit.* p. 277). Nor does the trail of *Limulus* correspond exactly with the fossil tracks; the edges of its carapace produce, in crawling, side-furrows not seen in *Protichnites;* and its subaquatic trail has but a general resemblance to *Climactichnites*, as far as we can learn from the published observations.

Dr. Dawson, in his interesting paper before me, also notices (p. 275) the occurrence, at Orchard Beach, of "small Climactichnite-like tracks" that were made, as he ascertained, by a large beetle (*Melolontha (Polyphylla) variolosa?*), "which occasionally settled on the wet sand and crept for some distance on its surface, apparently making the transverse tracks by means of its tarsi." A figure of this insect-track would have been very acceptable in connection with the subject treated of in my above-mentioned paper, *loc. cit.* p. 132, etc.

T. RUPERT JONES.

Royal Military College, Sandhurst.

BRITISH ASSOCIATION MEETING AT CAMBRIDGE.

ON THE CORELATION OF THE SLATES AND LIMESTONES OF DEVON AND CORNWALL WITH THE OLD RED SANDSTONES OF SCOTLAND.

By W. PENGELLY, F.G.S.

The distinguished author of 'Siluria,' as geologists well know, has made a tripartite division of the slates and limestones of Devon and Cornwall, as well as of the Old Red Sandstones of Scotland, South Wales, etc., and given chronological equivalency to the upper, middle, and lower groups of each respectively. Thus he places the Barnstaple and Petherwin beds—the latter being characterized by the presence of *Clymenia* and *Cypridina*—on the horizon of the Upper Old Red, with its *Holoptychius* and *Phyllolepis;* the limestones of Torquay, Newton, and Plymouth, in which are found *Stringocephalus. Calceola, Bronteus, Acervularia,* etc., are made to synchronize with the deposits of Caithness, etc., containing the remains of *Asterolepis, Coccosteus,* etc.; whilst the slates of Meadfoot, etc., in South Devon, and Looe, etc., in Cornwall, distinguished by the remarkable Coral *Pleurodictyum problematicum,* are regarded as the equivalents in time of the Lower Old Red rocks of Forfar and the North-east Highlands, which are charged with *Cephalaspis, Pteraspis,* and *Onchus.**

Though this co-ordination may be said to have met a large acceptance, it is not in keeping with the opinions of some who laboured long and sedulously amongst the older rocks of Devon and Cornwall, nor is it unchallenged by some existing writers. The late Sir Henry De la Beche regarded "the bulk of the Devonshire and Cornish rocks as, at least in part, equivalent to the lower beds of the Carboniferous Limestone, to the passage beds between the Old Red Sandstone and Carboniferous Limestone of Ireland, South Wales, etc., and also to some portion of the higher part of the Old Red Sandstones of Herefordshire and adjacent districts."† The Rev. David Williams considered "the Devonian system as occupying an enormous interval between the Old Red Sandstone and Mountain Limestone."‡ Mr. Page says, "We shall use the term 'Devonian' as applying more particularly to the strata as developed in the south of England, and the term 'Old Red Sandstone' as more especially applicable to those of Scotland; believing, as we do, that the Caithness and Forfarshire beds are on a lower horizon than the English Devonians, and that it requires both developments to constitute the 'system' as at present understood by European and American geologists."§ Mr. Bete Jukes says, "It is quite possible that the slates and limestones of Devon,

* 'Siluria,' 3rd edit., p. 433.
† Memoirs Geol. Survey, vol. . p. 103.
‡ Report Royal Geol. Soc. of Cornwall, 1843, p. 123.
§ 'Advanced Text-Book of Geology,' p. 123.

and the red sandstones of South Wales, although each deposited within the same great period, are not strictly contemporaneous, but were formed at different parts of the period. Or it is possible the red sandstone series of South Wales is not a continuous series; that the lower part of it, at all events, is older than any of the Devon series, while the upper part may be newer than much of that series."*

That *some*—that *much*—diversity of opinion should exist, respecting the time relations of the two systems of rocks now under notice, is what might be expected when their lithological and palæontological dissimilarities are remembered; the northern beds are eminently arenaceous, whilst those in the south are almost exclusively argillaceous or calcareous; the former teem with fossil fish, and the latter with the exuviæ of molluscous and radiate animals; but, according to our fossil registers, Scotland does not yield the shells, corals, or sponges so abundant in Devonshire; nor are the ichthyolites of the former found in the latter area: they have no organic remains in common.

It will doubtless be remembered, however, that in his 'Palæozoic Fossils of Cornwall, Devon, and West Somerset,' Professor Phillips has figured and described as a scale of *Holoptychius*, a fossil found in the slates of Meadfoot, near Torquay, in South Devon.† It would seem that this identification has not been considered perfectly reliable, since the fossil has not found a place in subsequent works on the Devonshire beds, or in Professor Morris's 'Catalogue of British Fossils.'

This dissimilarity of the organisms of two not very widely separated, and, as has been supposed, contemporary sets of deposits, is, to say the least, very remarkable. The mineral and mechanical characters of the Old Red rocks may sufficiently explain the absence, in them, of mollusks, and other dwellers at the sea-bottom; but there seems no satisfactory mode of accounting for the non-appearance of fishes in the slates and limestones of Devon and Cornwall. Various solutions of the problem have been attempted. We are asked by one to suppose that some geographical difficulty or barrier separated the two areas and prevented the migration and mingling of their inhabitants; whilst another suggests that the Old Red fish were probably at home in fresh water only, and ought not to be looked for in beds so decidedly marine as those of Devon and Cornwall.

The interesting and important discovery, by Sir R. I. Murchison, of the intermixture, in the same Devonian bed in Russia, of the fish of the Upper and Middle Old Red of Scotland with the shells of Devonshire,‡ leaves the difficulty untouched; nor does it appear that the synchronism of the representative beds in Britain necessarily flows from it. It proves, of course, that the fish and shells lived at one and the same time in Russian, not that they did so in British, waters. We may have an example, here, of the distinction between geological *contemporaneity* and *synchrony*, so ably pointed out, on a recent occasion, by Professor Huxley.§ It is possible, for instance, that the fish commenced existence before the shells; that they appeared in Scotland long before their descent upon Russia; that slowly changing conditions compelled them tardily to abandon their earlier home for a more congenial one; and that, on their arrival, they found there the invertebrate tribes which subsequently migrated to where the foundations of the future Devon and Cornwall were being laid.

Be this as it may, some geologists, recognizing the synchronism of the

* 'Manual of Geology,' 2nd edit. (1862), p. 492.

† Pal. Fossils, pl. 57, fig. 256, p. 133.

‡ 'Siluria,' 3rd edit., p. 382.

§ Anniversary Address, Quart. Journ. Geol. Soc., vol. xvii. part 2.

two systems of deposits, and believing that no sufficient reason had been assigned for the absence of the Old Red fish in Devon and Cornwall, have never failed to cherish the belief that, sooner or later, they would be found there; and, indeed, we have heard from time to time that at length the wished-for ichthyolites have been exhumed in the southern area. At the meeting of the British Association held at Cork, in 1843, Mr. Peach brought under the notice of the Geological Section, certain fossils which had then recently been found by Mr. Couch, in the Devonian slates, near Polperro, in Cornwall. The palæontologists to whom they were then submitted considered them to be remains of fishes; and, indeed, the late Mr. Hugh Miller subsequently found a specimen amongst them, of which he said that "if he had found it in the Old Red Sandstone of Cromarty, he would have no hesitation in regarding it as a fragment of some dermal plate of *Asterolepis*." These fossils were found in great numbers in certain localities, and extended along the Cornish coast, at by no means wide intervals, from Fowey Harbour to the Rame Head; they were constantly spoken of as the "Polperro fish," and the slates in which they were found as the "Polperro fish-beds." At length, Professor M'Coy and Mr. Carter of Cambridge subjected them to a rigorous microscopic scrutiny, and pronounced them to be nothing more than sponges belonging to their new genus *Steganodictyum*, of which they formed two species, *S. Cornubicum* and *S. Carteri*. It may be doubted, however, whether certain fossils found with them were not true ichthyolites; indeed, one specimen which, a few years since, I found in the *Steganodictyum* beds at Looe, in Cornwall, has been pronounced, by Sir P. Egerton and others, to be a decided ichthyodorulite.* It has not been identified, however, even generically.

A few weeks since, I had the good fortune to find a fossil in the *Pleurodictyum* slates at Meadfoot, near Torquay; that is, in certainly the lowest group of the rocks of South Devon and Cornwall, and which Sir R. Murchison has placed on the horizon of the *Cephalaspidian* and *Pteraspidian* beds—the lowest of his divisions of the Old Red of Scotland. From the first, I believed it to be a fish-scale or plate; and very recently, Mr. Davies, of the British Museum, has not only confirmed this, but has identified the fossil as a scale—or rather, a portion of one—of *Phyllolepis concentricus*, a fish known only by its fossil scales, and which had hitherto been found only in the Clashbennie beds, belonging to Sir R. I. Murchison's Upper Old Red.

This fossil then appears to necessitate the belief, either that the organism which it represents had a greater vertical range than has been supposed,—that is, that it belonged to the Lower and Middle, as well as Upper Old Red fauna,—or that the *Pleurodictyum* beds of Devon and Cornwall, instead of being on the horizon of the Lower, are on that of the Upper Old Red series of Scotland.

To accept the first of these, apparently the only two alternatives, would be to accept the difficulty of supposing that *Phyllolepis* dates from Cephalaspidian times; that it witnessed the extinction of this family as well as the subsequent introduction and withdrawal of *Coccosteus*, *Asterolepis*, and others; and yet that, unlike its early contemporaries, it failed to leave behind any trace of its existence in the Old Red rocks, save only in the upper of their three groups.

Rejecting this hypothesis, however, we seem compelled to adopt its rival, which amounts to this:—there are in Devon and Cornwall no representatives of the Lower and Middle Old Red rocks of Scotland, but the lowest—the *Pleurodictyum* beds—of the former are on the horizon of the

* See 'Geologist,' vol. iv. pl. vi. p. 346.

upper division of the latter; an opinion probably in harmony with that of Sir H. De la Beche already quoted.

In an earlier paper on this subject—based exclusively on the statistics of the invertebrate fossils of Devon and Cornwall, considered both specifically and generically—I expressed the opinion, that the lowest beds of Devonshire do not constitute the basement of the Devonian system, and that the Barnstaple beds were rather Carboniferous than Devonian, or were, perhaps, "passage-beds" between them.* It is not without interest to find this opinion supported by the more reliable, because vertebrate, evidence now produced. It will be remembered, too, that the indications of the Holoptychian scale, already mentioned as having been described by Professor Phillips, and which was also found in the Meadfoot slates, are to the same effect.

Like the Old Red Sandstone fish found in Russia by Sir R. Murchison, the *Phyllolepis* scale was surrounded with marine shells,† and also by corals of the family *Cyathophyllidæ*; the ancient fish to which it belonged was therefore not incapable of living in the sea.‡

NOTICE OF FOSSILIZED MAMMALIAN REMAINS FROM THE BED OF THE GERMAN OCEAN.

By C. B. Rose, F.G.S., etc.

It has for a very long period been known that, during the degradation of the cliffs of the counties of Norfolk, Suffolk, and Essex, teeth and bones of various mammals have been exhumed, and more largely those of pachyderms.

In Queen Elizabeth's time, huge bones were found at Walton, near Harwich. They were then considered to be those of giants. In the 'Philosophical Transactions' for 1745, a Mr. Baker records the finding of a fossil elephant at Mundesley Cliff; and, in 1746, Mr. Wm. Arderon, of Norwich, makes mention of similar remains discovered at Hasborough and Walket, on the Norfolk coast. My present object is, to lay before you a few of the specimens which have been brought up from the bed of the German Ocean, entangled in the trawling nets of the Yarmouth fishermen. Had they been more portable, I would have exhibited tusks and other large remains of these huge beasts, of which there are some fine specimens in the collection of Messrs. Owles, Steward, Nash, and my own. The late Miss Gurney, of Northreps, was the possessor of a large collection of fossil mammals from the cliffs of Cromer and its vicinity, and which may now be seen in the Museum at Norwich. The Rev. John Gunn, of Irstead, has made an extensive and rich collection of similar remains, from Mundesley and Hasborough.

In the course of years vast numbers of teeth and bones have been collected. The late Mr. Woodward, of Norwich, says, in his 'Geology of Norfolk,' "Mammalian remains have been dredged up on the Knole Sand, off Hasborough. This spot presented us, in 1826, with the finest tusk of the mammoth; it measured 9½ feet along its curvature, and weighed 97 lbs." But off Dungeness a tusk was dredged up which measured 11 feet in length, and yielded some pieces of ivory fit for manufacture. The oyster-bed off Hasborough was discovered in 1820, and, from the number of grinders of the elephant found there, Mr. Woodward felt himself war-

* 'Geologist,' vol. v. pp. 28 and 31. † 'Siluria,' 3rd edit., pp. 383 and 433.

‡ This scale has been transmitted to me and will shortly be figured.—Ed. Geol.

ranted in concluding that upwards of 500 animals were deposited in that limited space.

The coloured map of the German Ocean exhibited at the meeting, showed the localities whence the organic remains are chiefly taken; certain spots marked thereon are the fishing-grounds, and, therefore, the depositories of the fossils with which we are made familiar; but we cannot doubt that these exuviæ are more generally distributed over the sea-bottom. The following specimens were exhibited:—Teeth of three species of elephant, *Elephas primigenius, E. antiquus*, and *E. meridionalis;* cervical and dorsal vertebræ of the same genus; two teeth of a hippopotamus (a dorsal vertebra has since been brought up); a dorsal vertebra of a whale; a unique specimen of a lower jaw of the *Trichechus rosmarus;* heads of the *Megaceros Hibernicus*, male and female; an anterior dorsal vertebra of ditto (an antler, 4 feet 6 inches long, has since been brought me); atlas of ditto; a fragment of an antler of *Cervus tarandus;* the humerus of a gigantic ox; a portion of the head of the *Equus fossilis;* and a fine specimen of *Castor Europæus,* the head. The colour of these specimens might lead us to believe that they belonged to the Mammaliferous Crag period; but colour is not a decisive criterion. It is probable that they may have lain in close proximity to a bed of crag;* they are unquestionably from a Pleistocene deposit.

And, now, as to how these organic remains came to be at the bottom of the ocean. At a not very remote geological period our island was united with the continent; a catastrophe took place which separated them and led to the formation of the German Ocean. This gap has been continually enlarging, from the crumbling down of the cliffs on either side; the fossils have thus been exhumed, carried out to sea during storms by retiring waves, and there deposited. No doubt, also, that many remains which lie buried in the land that originally united us to the continent sank bodily with it, and consequently they are met with when the sea-bottom is raked over by the trawling-nets of the fishermen.

P.S.—I give the measurement of three tusks. One, belonging to Mr. Owles, measures—length of external curve, 7 feet 5 inches; girth at proximal end, 18 inches; radius of inner curve, 3 feet.

I possess two perfect tusks—one, length, 6 feet 3 inches; girth, 17 inches; radius of curve, 3 feet 3 inches: the other, length, 6 feet; girth, 12½ inches; radius of curve, 4 feet 2 inches. These proportions indicate that my specimens are from two distinct species of the elephant.

A femur of the mammoth in my possession measures 3 feet 5 inches, minus the head of the bone, which is gone.

The late Rev. Mr. Layton possessed the finest collection of mammalian remains from the Norfolk coast. At his death it was purchased for the British Museum.

NOTES ON DEEP OR ARTESIAN WELLS AT NORWICH.

By the Rev. J. Crompton.

The object of this paper is to put on record the facts connected with the attempt now being made by Messrs. J. and J. Colman, of London and Norwich, to bore a deep well through the chalk to the Lower Greensand. Mr. Rose, of Yarmouth, in the 'Proceedings of the Geologists' Associa-

* The atlas of the *Megaceros* has a *Turritella incrassata* (Crag fossil) sticking in the canal for the vertebral artery.

tion,' No. 8, 1862, has mentioned some of these facts, but it seemed worth while to throw them together in a distinct memorial, if only to draw attention to an enterprising and patiently-conducted operation of great extent, by a single commercial firm, in obedience to geological principles.

The wells (for there have been two attempts) are situated at the foot of Carrow and Bracondale Hill, Norwich, within a few yards of the river Wensum, the object of the deep sinking being to obtain a water, for use in the manufacture of starch, perfectly free from the impurities of that found within the range of the chalk of the neighbourhood.

The operation chosen is that of boring by Messrs. Mather and Platt's machine. This machine consists of an iron boring-head, 8 or 10 feet in length, armed with strong chisels, suspended by a *flat rope* wound round a drum; the hammering or "jumping" motion being given by a special steam piston. The neck of the borer is formed with a screw, on which a collar connected with the flat rope works, the effect being that the borer is gradually twisted when at work, so that the chisels constantly strike on fresh points, and more thoroughly break up the materials met with. When a sufficient quantity has been thus broken up, the boring-head is removed and a "shell-pump" is let down having a valve at the base. On the pump being set in action, the loose material is forced into the shell and brought to the surface. In the hard chalk the rate of penetration accomplished was 20 to 25 feet a day for 500 feet.

The first well failed in consequence of the iron tubing employed to case the bore slipping across and completely obstructing the action of the machine, at a depth of 775 feet.

The second is being sunk a few yards off, on the same level as the first. After a few feet of alluvium the borer passed through hard chalk, with flints at distances of about 6 or 7 feet apart, for 700 feet, with the exception of 10 feet at the depth of 500 feet, where the rock was soft, "like white lead," and of a rusty colour. Thence the hard chalk continued, with flints thicker together, viz. about 4 feet apart, to the depth of 1050 feet. Then 102 feet were pierced, of chalk *free* from *flints*, to the Upper Greensand, a stratum of about 6 feet, and next the gault for 36 feet: the whole boring being full of water to within 16 feet of the surface.

In this gault, however, the greatest obstacle has been met, and the completion of the work arrested for a considerable time past. This stratum is soft, so that the chisels, effective in the harder upper strata, are of little use. The material caves in from all sides as the instrument proceeds, and, unfortunately, the rope has broken more than once, leaving the boring-head below, and one now lying across the bore baffles the engineer's efforts to remove it.

The strata passed through are—

	Feet.	
Alluvium	12	
Hard chalk, with flints	483	1042
Soft chalk	10	
Hard chalk, as before	190	
Hard chalk, with flints, in closer layers	350	
Chalk, without flints	102	
Upper Greensand	6	
Gault, not yet passed through	36	
	1198	

The fossils brought up have not been very numerous, as might be expected from the smallness of the bore, viz. twenty-one inches in diameter.

The larger proportion have been from the lower strata, especially the gault.

From the chalk the ordinary fossils, as the *Spatangus cordiformis*, have been taken; three sharks' teeth, one that of *Lamna Mantellii.* From the gault, as noticed by Mr. Rose, characteristic small Belemnites, with *Ammonites lautus*, *Ammonites symmetricus*, and fragments of *Inoceramus*.

The Foraminifera as yet detected by my friend Mr. Kitton, of Norwich, whose accuracy of observation as well as kindness I have to thank, are—in the gault, *Orbulina* (common); *Lagena* (rare); *Nodosaria* (not uncommon); *Frondicularia* (rare); *Dentalina* (not uncommon); *Entosolenia* (rare); *Rotalina* (not uncommon); *Polymorphina* (ditto); *Textularia* (common); *Globigerina* (ditto). Fragments of Bryozoa occasionally occur.

In the chalk at 500 feet depth the Foraminifera are more sparsely distributed, and much more injured than in the gault. They consist principally of two genera, *Globigerina* and *Textularia*. *Rotalina* are somewhat more rare. The same is the case with the samples examined from 110, 400, and 1000 feet in depth.

The work, from the unfortunate cause mentioned, is arrested apparently on the point of success, to the great annoyance of the enterprising proprietors; and, although our business here is with the scientific facts presented, the geological section will not hesitate to recognize one more instance in which the science of geology has received practical homage from a private commercial firm in a work of considerable boldness, carried on for three years in the face of temporary defeats, with admirable courage and faith in the dictates of geology.

The other papers read in the Geological Section were: — Opening Address by Mr. J. B. Jukes; "On a Whittled Bone from the Barnwell Gravel," by Mr. Harry Seeley; "On Tertiary Coal," by Prof. Ansted; "Alluvial Deposits on the Rhine," by R. H. C. Godwin-Austen, F.R.S.; "On an Ancient Sea-beach at Fort William," by Mr. J. Gwyn Jeffreys; "Glacial Deposits of Highlands of Scotland," by Rev. S. W. King; "On Wookey Hole Hyæna Den," by Mr. W. Boyd Dawkins; "Last Eruption of Vesuvius," by Dr. Daubeny; "Extinct Volcano in Upper Burmah," by Mr. W. T. Blandford; "Comparative Structure of Artificial and Natural Igneous Rocks," by H. C. Sorby, F.R.S.; "General Review of Cambrian Rocks," and "Older Metamorphic Rocks and their Fossil Contents," by Dr. Bigsby; "Contributions to Australian Mesozoic Geology," by Mr. C. Moore; "Correlation of Iron-slates and Limestones of Devon and Cornwall with Old Red Sandstone of Scotland," by Mr. W. Pengelly; "Six-inch Maps of Bronan district, Co. Clare," by Mr. F. J. Foot; "Gold-fields of Auckland" and "Gold-fields of Otago," by Dr. L. W. Lindsay; "Tooth of Mastodon from Tertiary Marls, Shanghai," by Prof. Owen; "New Recent Echinoderm and its probable Palæontological Affinities," by Dr. Allman; "Identity of Upper Old Red Sandstone with the Uppermost Devonian, and of the Middle and Lower Old Red with the Middle and Lower Devonian," by Mr. J. W. Salter; "Skull of *Rhinoceros tichorhinus*," by S. P. Saville; "Supplementary Report on Slaty Cleavage," by Prof. Phillips; "Composition of Granite of Donegal," by Dr. T. Sterry Hunt; "Ossiferous Caves in Malta," by Dr. Falconer; "Glacial Phenomena of Upper Indus," by Captain Godwin-Austen; "Fossils of Boulder Clay in Caithness," by Mr. C. W. Peach; "Mammalian Remains from Bed of German Ocean," by Mr. C. B. Rose; "Flint Implements from North Devon," by Rev. J. Dingle; "Veins in the Models of Foraminifera," by Dr. Pritsch; "Diluvial and Alluvial Deposits of Central Germany, and on the Climate of the Period," by Dr. von Seebach; "On Petroleum of North America," and "Structure and Origin of Certain Limestones and Dolomites," by Dr. T. Sterry Hunt; "Plesiosaurus from Lias of Whitby," by Mr. F. J. Foot; "Flint Implements from the 'Oyle' Cave, Tenby," by Mr. G. N. Smith; "Scutes of Labyrinthodon from Keuper Bone-Breccia of Pendock," by Rev. W. S. Symonds; "New Fossil Fishes from Old Red Sandstone, Caithness," by Mr. C. W. Peach.

PROCEEDINGS OF GEOLOGICAL SOCIETIES.

Geological Society.—*November* 5, 1862.—Professor A. C. Ramsay, President, in the chair.—1. "Descriptions of some Fossils from India, discovered by Dr. Fleming of Edinburgh." By Dr. L. de Koninck.

The author gave a detailed description of 44 species of fossils from the western end of the salt-range of the Punjaub, on the right bank of the Indus, discovered by Dr. J. Fleming and Mr. W. Purdon. The same mixture of Mesozoic with Palæozoic types observed by Mr. Davidson, who described the Brachiopoda (Quart. Journ. Geol. Soc. vol. xviii. p. 25), was also noticed by the author in these fossils. He therefore suggests the possibility of a further examination of the strata showing the existence of two intimately associated formations, belonging respectively to the Carboniferous and Lower Mesozoic periods.

2. "On a Deposit containing Diatomaceæ, Leaves, etc., in the Iron-ore Mines near Ulverston." By Miss E. Hodgson.

The object of this paper was to show that this deposit, which was first described by Mr. Bolton in the Society's Journal, vol. xviii. p. 274, and considered by him to be of lacustrine origin, was deposited in a large cavern or chain of caverns by a subterranean stream originating probably in a brook called the "Poaka Beck."

3. "On the Geology of a Part of the Masulipatam District." By Capt. F. Applegarth, Madras Army.

4. "On the Association of Granite with the Tertiary Strata near Kingston." By J. G. Sawkins, Esq., F.G.S.

A granitic formation traverses Jamaica in a direction from S.E. to N.W., being the same as that of the earthquake-shocks. It pierces the Carbonaceous series, and also the Tertiary strata, whence the author concludes that it is of Tertiary age.

Manchester Geological Society.—*June 24th.*—Mr. Hull, of the Geological Survey, drew attention to the presence of *Goniatites*, *Aviculopecten papyraceus*, and other marine shells in the upper coal-measures at Dukinfield. It has always been considered that these marine fossils were confined to the lower coal-measures, and to the series of strata below the Arley mine.

Mr. Binney delivered an address "On the Geology of Manchester." The surface around Manchester was covered by drift, except in the valleys, where the rivers have cut through the drift. The drift of the district Mr. Binney divides into—

1. *Valley gravel.*—A bed of coarse gravel, composed of various-sized Azoic, Palæozoic, and a few Triassic rocks, well rounded, parted with layers of

fine sand, without pebbles, exhibiting every appearance of having been deposited by water; most frequently stratified, but sometimes unstratified. It has generally two well-marked terraces above the waters of the present rivers, as well as some minor terraces. On the top of this is generally found about three or four feet of silty loam.

2. *Forest sand and gravel.*—A deposit of sharp forest sand, parted with layers of gravel of same rocks as No. 1, and having every appearance of a regular deposit by water, distinguishable only from No. 1 by its being

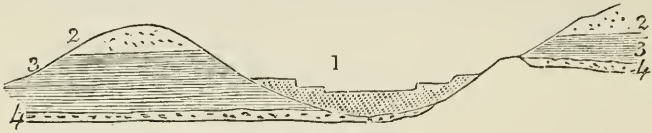


Fig. 1.

found at greater elevations, containing more sand, and being generally more regularly stratified. It sometimes contains thin beds of "till" lying in it, and much drifted coal.

3. *Till.*—"Till," a mass of strong brown clay, in which are mingled the same kinds of rocks as those in Nos. 1 and 2, of sizes from six tons in weight to small pebbles, some rounded and partly rounded, and others quite angular, especially coal-measure and magnesian limestone rocks, without any order of deposition, great and small stones being mixed together indiscriminately, quite impervious to water, and well known as valuable brick clay, and from its being the deposit which yields *striated* or *scored* stones. Several beds of fine laminated silt and patches of sand are found in it.

4. *Lower gravel.*—A bed of sand or coarse gravel, having the pebbles (consisting of the same kinds of rocks as Nos. 1, 2, and 3) well rounded, sometimes, but not always, occurring under the brick clay, often stratified, and at other times unstratified. It affords good springs of bright water.

Probably the deposits mentioned above will not always be found in the perfect order there laid down; no doubt some of them may be wanting at places, especially Nos. 4 and 2, which have often been removed.

The kind of gravel found here is somewhat similar to that in the north of France yielding flint implements. Many things have been found in these gravels, but have always been considered of doubtful origin. Some of the old beds of the course of the present river Irwell have been dug out, but little attention has been given to collecting anything from them. It is to be wished that attention were directed to these lowest terrace beds, with a view of ascertaining whether they contain any flint implements or fossil remains. Mr. Barr had stated that he had found a marine shell (*Cardium edule*) in the gravel of Stockport. On the top of the gravel is a bed of silt, three or four feet thick, and this seems to have been derived from floods, when the river overflowed its banks and deposited the silt. In the upper terrace there are very often found thin beds of peat, and beds of silt between.

The great body of gravel, about the level of the waters of the Irwell, has been moved about in the valley as the river has changed its course from time to time. A singular curve of the river occurs below Kersall Moor, which shows that the river may have gone straight across from Douglas mill to the place where the present suspension bridge is erected, a few hundred years ago, for the river on the Salford side is now encroaching on the Broughton side, and the Broughton side is encroaching on that of

Salford at other points. From some of the old plans connected with the Broughton estate it is more than probable that evidence might be got as to what was really the course of the river 200 or 300 years ago, and thus show the rate of change of the river-course per year. Several acres of Salford are found on the Kersall side, and about the same quantity of Kersall on the Salford side of the river, clearly proving that there have been some singular changes since maps were made; for the river was doubtless once the boundary line of the two townships. The waters in the valley there have, no doubt, been of much greater volume than they are at present, or they could not have removed the materials from the spaces between the terraces.

The brick clay, or "till," has been proved to be thirty yards thick, and contains fragments and boulders from azoic and palæozoic rocks of nearly all kinds, with a few secondary rocks.

In the neighbourhood of Tib Lane, the bed of clay is parted with quicksand, and the till seems gradually to go out and the quicksand to come in. This quicksand is found in several parts of Manchester. A singular fact in regard to the junction of the sand and the till sometimes presents itself, namely, the wedge-like manner in which the sand sometimes enters the till at the junction of the two (Fig. 2).

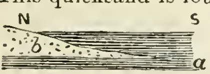


Fig. 2.

The last bed of drift is the lower sand and gravel. This formation is not much seen in the neighbourhood of Manchester. It is only in sinking wells and boring holes that it is occasionally met with. It would be desirable to know what sort of fossils, if any, are to be found in it. The bed has been sometimes found to be ten or eleven yards thick.

The Secondary beds found in the neighbourhood of Manchester consist of Trias rock. In some parts of the town it is from 200 to 300 yards thick. The palæozoic rocks are the Permian and Carboniferous.

In the discussion which followed, Mr. Atkinson said it had occurred to him that this valley gravel was really marine gravel, and that there had been a communication with the sea up the valleys of the Mersey and Irwell. Manchester, he added, was very few feet above the level of the sea; and the tide came even now to Warrington.

Mr. Binney stated that most of the points even of the valley gravel are about 100 feet above the level of the sea.

Mr. Hull dissented from the opinion that these valley gravels were of marine origin. He formerly entertained the opinion that they were, but there was one reason which he could advance which appeared to him to be decisive that they were old river terraces, and that was the fact that the slope of their upper surfaces coincides with the present slope of the river. If the valley gravels were old sea or marine gravels they would necessarily be very nearly horizontal, and at any rate the change in the level of the upper surface would necessarily be very slight, because in order that the sea should ascend to such a height as 160 feet above the present level, it would require a general submergence of land.

Mr. Plant said he could corroborate the views of Mr. Hull relative to the freshwater character of the upper gravel, from excavations made when sinking for the foundations of the Museum in Peel Park.

London Institution.—A very interesting course of six lectures, on "The Operation of Heat in the Production of Geological Phenomena; with reference, principally, to those of Volcanos and Earthquakes," is now being delivered by E. W. Brayley, Esq., F.R.S., F.G.S. The syllabus is so full that it will prove useful to many of our readers:—

Lecture I. (*Nov.* 12.)—Volcanos and earthquakes the most obvious manifestations of the nternal heat of the globe at the present epoch of its physical history. Their philosophy constitutes one great division of the science of IGNEOUS GEOLOGY. Plutonic action, an effect of the same cause, but deeply and entirely subterranean, the subject of another division of that science. These lectures appropriated chiefly to the former. Succession of volcanic phenomena. The *Eruptions*, principally of intensely-heated aqueous vapour in torrents mingled with mineral matter, through fissures in the superficial crust of the globe, by which volcanos are formed, and in which their characteristic phenomena consist. May be subaërial or submarine; on the land or the bed of the ocean. The coruscations of lightning observed in volcanic eruptions. The circumstances of their production formerly shown to be analogous to those of the electric sparks from high-pressure steam issuing from a boiler, first described by Sir W. G. Armstrong. The source of electricity in that case proved by Dr. Faraday to be the friction of water and steam against other bodies. The entire process of excitation identical in both cases, and *volcanic lightning*, therefore, probably the greatest example of frictional electricity in Nature. Accumulation of materials ejected in volcanic eruptions into a conical mountain, perforated by a kind of chimney, terminating at the summit in a funnel-shaped cavity called the *crater*. Intimate nature and immediate causes of eruptions. Characters and history of the currents of *lava* or molten rock, which rise up the chimney into the crater, and stream from it down the exterior of the cone, or flow through fissures in its flanks or near the base. Alternate production and repletion of the crater. Paroxysmal, continued, and permanent eruptions. Various phases of volcanic action. Active and extinct volcanos.

LECTURE II. (*Nov.* 19.)—Products of volcanic eruptions, aeriform, liquid, and solid; the latter being of all dimensions, from blocks of enormous size to fine sand. Subsequent consolidation of comminuted and pulverulent ejections, often exceeding the lavas in collective bulk, by means of water, into the substance called volcanic tufa or tuff. Many kinds of minerals ejected, others formed during or after eruptions. Lavas are of two kinds, the granular or *stony*, and the *vitreous* or glassy; their varieties constituting an important class of the IGNEOUS ROCKS of geologists. The former may be arranged in general into three groups, basaltic, greystone, and trachytic lavas, all which are essentially aggregates of crystalline minerals, chiefly felspar, leucite, olivine, augite or pyroxene, and probably some others containing combined water; these minerals, chemically, being silicates of various earthy and alkaline bases, including oxide of iron, which also occurs separately as a mineral element of lavas in the form of titaniferous magnetic oxide of that metal. The peculiar nature of the fluidity of the Stony Lavas indicated by Dolomieu; but their true hydroplastic condition in the flowing state first observed and described, and the functions of water and its vapour in volcanic phenomena first adequately recognized, by Mr. G. Poulett Scrope. Probable agency in the production and effusion of lavas of the correlation and mutual convertibility of heat and mechanical force. The stony lavas apparently formed beneath the volcano by the disaggregation of previously existing lavas or other crystalline rocks, effected by the expansive force, pressure, and solvent action of steam at a high temperature. This process a cooling one, and therefore the materials resulting from it not fused, but mingled with water and steam into a kind of ignited or incandescent mud, in which the fluid element, water or aqueous vapour, exists in a peculiar state of adhesion to and intervention between the surfaces of the mineral crystals and other solid particles. The Glassy Lavas (of three principal kinds, called obsidian, pitchstone, and pearlstone), formed originally by the opposite process of the conversion of mechanical force into heat, resulting in true melting or igneous fusion, at a still higher temperature than that at which the stony lavas become flowing. When steam is developed in them they become a kind of froth, which solidifies into pumice. Some plutonic or hypogenous crystalline rocks, such as granite, also formed by a process of true fusion, in which water is an essential agent; but these are of a distinct nature from that of lavas, and if they pass through the hydroplastic condition are not raised in it to the surface of the earth, though they supply part of the materials for subsequent disintegration or fusion into lavas. All igneous rocks, however, graduate into each other in a manner variously related to their chemical constituents and composition, or those of the minerals which constitute them, and to the temperature at which they are formed and the time occupied in their solidification. Occasional sudden re-incandescence of lava, with explosive discharge of steam, long after it has ceased to flow and become consolidated, being apparently the occurrence, on a small scale, of the essential physical process of eruption.

LECTURE III. (*Nov.* 26.)—Volcanos mountains of ejection and accumulation, but not of elevation. Researches on this subject of Mr. Scrope, Sir Charles Lyell, and M. H. de Saussure. Peculiar conical form and structure of volcanic mountains, their disposition in groups or lines connected with fissures in the earth's superficial crust, and Geographical Distribution. May be slowly or rapidly produced, but, when formed on the land, are always of long duration. Have probably existed at all known geological periods, and some which were active in the later Tertiary or *Cainozoic* eras are active now (as Etna), while others are extinct (as the volcanos of Central France and Asia Minor). One volcanic cone may envelope and bury others in its ejections, or one chain of volcanic vents may overwhelm another under its lavas and tuffs, and so preserve them as a part of itself, as observed in Madeira by Sir Charles Lyell and M. Hartung; but as volcanic cones cannot in any other sense become subterranean, nor long remain beneath the sea, there are *not any Fossil Volcanos.* Of those, therefore, which were active in the Mesozoic and Palæozoic eras of geology, certain products only remain. Such products abundant in Britain, as exemplified in the middle series of Cambrian Slates, and the Western Islands of Scotland. In what manner volcanos are related to the elevation of the land and of other mountains, and to the production of the actual surface of the globe. Probably only the features of that surface produced by the direct action of the internal forces, as recently indicated by Mr. Jukes. Enormous mass of materials transferred by them from below to the surface.

LECTURE IV. (*Dec.* 3.)—Volcanos not the cause of earthquakes nor earthquakes of volcanos, as commonly supposed; but both the "manifestations of a common force under different conditions," or the partial effects of a common cause, or of a common series of causes, originating in the internal heat of the globe. Particular history of some of the most remarkable earthquakes.—Those of Lisbon, November 1st, 1755; Calabria and Sicily, February and March, 1783: Riobamba, in Peru, February 4th, 1797, the greatest earthquake whose effects have been observed; Chilé, February 20th, 1835, and concomitant volcanic phenomena; Southern Italy, December 16th, 1857. Succession of earthquake phenomena when taking place on land or under the ocean. The ground and all objects resting upon it suddenly moved backwards and forwards by an alternate horizontal motion, accompanied by a vertical or upward and downward motion. Duration of the shock. A continuous violent tremor often felt in addition. Great sea-wave attending earthquakes. Sounds which accompany them when subterranean fractures occur. Earthquakes do not occasion permanent elevation or depression of the land or sea-bed (for reasons to be explained in the next lecture), contrary to what is often affirmed by geologists, though such changes of level may take place at the same time. Occur over all parts of the earth's surface, but certain areas of land and sea more subject to them than others. Geographical distribution of these areas, or *Seismic regions,* and its relation to that of volcanos. In what manner the occurrence of earthquakes and the eruptions of volcanos are related. Alleged and possible influence of the unequal attraction of the moon, and of the varying pressure of the atmosphere on the occurrence of earthquakes. Certain districts of Great Britain subject to slight earthquake-shocks at the present time.

LECTURE V. (*Dec.* 10.)—The philosophy of earthquakes constitutes the new department of science termed SEISMOLOGY. Analysis of their phenomena. The shock, or earthquake-wave, a true roll, or continued undulation of the solid crust of the earth. Earthquake-motion shown to be undulatory, or *wave-like,* by Michell, about a century ago; but erroneously assimilated by him to that of ordinary liquid superficial waves, such as those of the sea, which it only apparently resembles. The Dynamics of Earthquakes first explained, and the true nature of their motion, as being that of a Wave of Elastic Compression, demonstrated, by Mr. Robert Mallet, in 1846. Waves of elastic compression may be communicated to, or originate within, the substance of matter of every kind, aeriform, liquid, and solid; as the atmosphere, the waters, and the earth; becoming sensible as sound, in all three mediums, and also, in the case of the earth-wave, as *Seismic* or earthquake phenomena. These waves consist of an alternate condensation and rarefaction of the medium; the particles of fluid or solid alternately approaching and receding from each other, in continuous succession, and in all directions from the central or focal point where the impulse takes place which gives origin to the wave. An earthquake the transit or passage of such a wave, or of a succession of such waves, through the substance and surface of the disturbed country, with immense rapidity, from a focal point at a considerable depth. The velocity of the *wave-transit* very great (above thirteen miles in a minute), but that of the *particles* in wave-movement comparatively very small. The earthquake-wave, and, when subterranean sounds occur, the sound-wave, in the same geological formations, travel with the same speed, the sound-waves through the sea and the air somewhat slower. Why no permanent change of the level of the ground can be occasioned by an earthquake. The original subterranean impulse percussive, or of the nature of a blow, and probably caused by the sudden formation, extrication from hydroplastic matter, expansion, or condensation of steam of high tension (high pressure), the heat of which, either directly or mediately and virtually, becomes mechanical force. That force may also be exerted through the instrumentality of the molten rock itself, and originate earthquakes by the violent fracture of strata or other solid masses of the crust. Means and instruments for observing and recording the occurrence, direction, and velocity of earthquake-movements, called *Seismometers* and *Seismoscopes*, some of them self-registering. Application of the electric telegraph to *Seismometry*. Nomenclature of the "Elements" of Seismology. The first exact investigation of the phenomena of a great earthquake made by Mr. Mallet, in the case of that of Southern Italy in 1857. Principal results of that investigation. Obligations of science on this new subject, regarded as one of accurate inquiry, due to the British Association for its Advancement, and the Royal Society, to Mr. R. Mallet and Dr. J. W. Mallet, and also to Professor Alexis Perrey, of Dijon, Mr. D. Milne, and other contemporary inquirers.

LECTURE VI. (*Jan.* 7, 1863.)—Central or internal heat of the globe; its mechanical and physical and its chemical effects. Its operation, both direct and by the correlative forces into which it is converted, in the production of Plutonic and that of Volcanic and Seismic phenomena respectively. Compatibility, convergence, and probable identification of the thermotic theories of those phenomena, founded on the old conception of a primitive internal heat, with the theory which refers them to chemical action, originally proposed by Sir H. Davy, and advocated by Dr. Daubeny, Professor Bunsen, and other chemists and geologists of the present time; as argued in previous Lectures on Igneous Geology. The latter theory, thus regarded, supplies the superficial cause of high temperature in the earth's crust, shown, by the recent experimental and mathematical investigations of Mr. W. Hopkins, to be required, in order to account for the observed increase of temperature in descending within the earth. Volcanos and earthquakes, accordingly, probably the immediate results of a secondary and local generation of heat, arising from a circulation of Chemical affinities in the alternate Reduction and Oxidation of Combustible Bases, and taking place in cavities of the superficial solid crust, in which earthquake-waves originate, and of which volcanos are communications with the surface. Such chemical action excited by the transfer of the earth's central heat towards the surface, occasioned by the change of position of the matter constituting the superficial crust, effected by the action of the Sun upon the exterior of the Globe. Theoretical indication, formerly adduced, of another source of terrestrial temperature, originating in the Correlation of Forces, and which also would excite chemical action and give rise to the same series of effects and phenomena. Transition from plutonic to volcanic action. Quantity of matter ejected by volcanos on the surface of the globe probably equivalent to that in which the series of physical processes commenced by the solar action in the atmosphere and the waters terminates by depositing on the bed of the sea, in the form of sedimentary strata.

NOTES AND QUERIES.

THE KELLET SKULL.—With reference to the observations made by Mr. C. C. Blake and Professor Busk on this subject, I enclose the following further information. Captain Barrie, R.N., writes to me, under date

October 2, 1862:—"I have been to the place where the Kellet skull was found, but, after a careful search, have been unable to pick up more than two small fragments of bones, I know not of what bones. The place where the skeleton was found is rather remarkable. The limestone rock hereabouts is generally split or rift in parallel lines, and greatly seamed on the surface, with holes, that make walking very dangerous when the surface is slippery. In one of these clefts, not much more than five feet long and one wide, lay the skeleton. It was some three or four feet from the top, and partially sheltered from the weather by the sides of the rock. At the bottom of the cleft are some bits of loose débris, and perhaps some fragments of bone among them, but I could only just reach a few, with my long arm bared and stretched to the utmost. The peasantry had a sort of holiday over the relics three months ago, and the children washed up many bones. They then put sods over the hole. There are perhaps other pieces down the narrow holes, which no human being can reach without breaking up the rock. What seems strange to me is, that the hole is so shaped as to have left no spare room even for a small human body. It must have been forced in and tightly jammed into its place. This has given rise to the idea that the individual was murdered; and the small size of the hole would lead me to think that the body was that of a woman or undersized man.—WILLIAM BOLLAERT, F.R.G.S.

GAULT BLACK VEN.—In the Jermyn Street Museum, I lately observed a few fossils marked "Gault Black Ven" (Lyme Regis). They were in dark clay, very like the Gault of Surrey. Could any of your correspondents inform me what is the precise position of this bed, whether above or below the deposits with "cowstones," as I do not remember having seen it mentioned in the papers of either Sir H. De la Beche or Mr. Godwin-Austen?

Of the fossils exhibited I find that the majority are also found in the whetstone beds of Blackdown, while only one (*Inoceramus concentricus*) is given in the lists in Jukes's 'Manual,' as occurring in the Gault elsewhere.

The identification of any one of the beds in the greensand outliers of the West of England with deposits exposed within the Wealden denudation would have an important bearing on the as yet unsolved question of the age of the Blackdown beds, and if undoubted Gault has been met with at Lyme Regis, a public notice of the fact would, I think, be interesting to students of the Lower Cretaceous formations.—C. EVANS.

[A paper on these beds will shortly be read at the Geological Society.—ED. GEOL.]

LOWER SILURIAN ROCKS IN MEATH.—The 'Dublin Quarterly Journal' for October publishes a Paper by Mr. W. H. Baily, F.G.S., "On the Occurrence of some characteristic Graptolites and other Fossils indicating certain Divisions of the Lower Silurian Rocks in the Counties of Meath, Tipperary, and Clare." The fossils which drew the author's attention to the subject were a small collection from black-green slates at Bellewstown Hill, amongst which were several specimens of the double Graptolite, *Didymograpsus Murchisonii*, so characteristic of the Llandeilo flags of North Wales. The fossils noted by Mr. Baily from this and other immediate localities, although not all from the same bed, are, from black slates, *Diplograpsus pristis*, *D. scalariformis*, *Orthis calligramma*, *O. alata*, *Discina*, *Graptolithus Sedgwickii*, *G. Nillssoni*, two species of *Lingula* and *Siphonotreta micula;* from grey slates, *Didymograpsus Murchisonii*, *Diplograpsus pristis*, *Lingula attenuata*. Some grey and brown sandy shales afforded fragments of *Acidaspis*, *Asaphus*, small univalves of the genera *Cyclonema Raphistoma*, *Ecculiomphalus*, several brachiopods, amongst them *Leptæna sericea*, *Strophomena depressa*, *Theca*, and the branching variety of small coral, *Stenopora fibrosa*. These latter beds Mr. Baily considers of Bala or Caradoc age, and therefore to overlie the Graptolite slates. Other Lower Silurian localities and fossils are noted in these districts in the paper.

Geology of Moffat.—In the 'Edinburgh New Philosophical Journal' for July, Mr. Wm. Carruthers, F.L.S., has described the geology of Moffat, in Dumfriesshire. Within a radius of four or five miles round the village, Silurian, Permian, a trap dyke, and the Boulder clay and gravel are met with. Peat also is abundant in the district. In the low grounds it contains the trunks of trees of species still growing in the district, namely hazel and birch.

Fossil Man.—*La Salle Presse* states that, in Macoupin county, Illinois, the bones of a man were recently found on a coal-bed capped with two feet of slate rock, ninety feet below the surface of the earth before the run cut any part. The bones, when found, were covered with a crust or coating of hard glossy matter, as black as coal itself, but when scraped away left the bones white and natural.

Bone Caves of Malta.—The excellent account of the fossiliferous caves of Malta, by Mr. Andrew Leith Adams, surgeon, 22nd Regt., read before the Dublin Royal Society in November last year, is printed in the October number of the 'Dublin Quarterly Journal of Science.' The caves described are on Maghlak, 300 feet above present sea-level, Ghar Hassan's, and one near Zebbug; and mammalian relics are noted from Crendi, Dingli, and Gozo. "We know not," says Mr. Adams, "and may never probably discover with any degree of accuracy, *when* the important phenomena occurred which ended in forming the Malta and Sicily of our times. That there was a connection between the two islands and Africa during the later Tertiary epochs seems highly probable—the fact of the African elephant having been found near Palermo, as well as complete skulls of a species of hyæna very like the animal of Africa, leads us towards the supposition that there was also a union between Sicily and that continent." Two plates, containing figures of the skull, teeth, lower jaw, etc., of *Myoxus Melitensis*, accompany the paper.

The Exhibition Frog.—Sir,—Lately there have been a great many letters in the 'Times' and other newspapers, regarding the *frog* stated to have been found in coal that has been displayed in the Exhibition. The different writers have different opinions, but amongst all of them I did not see the name of one practical geologist. May I ask one question—In the formation of coal, would there not have been an amount of heat produced that would inevitably have burnt the frog to a cinder?—C. W.

[In Vol. I. of this magazine, our inquirer will find a convincing argument against the absurd idea of living frogs embedded in coal. The reptiles of the Coal period were of labyrinthodont structure, and if it had been possible that a frog could have been embedded alive for myriads of years, which of course it is not, it would have had distinguishing labyrinthodont characters, and would not have been of a common recent Batrachian species. It does not follow, nor is it likely, that a high temperature must have been produced in the formation of coal. Many chemical operations accomplished *speedily* by high temperatures are effected naturally by *long-continued* action at lower temperatures.—Ed. Geol.]

Human Remains at Engihoul.—M. Malaise, a Belgian palæontologist, exploring in the province of Liége, has recently discovered certain fragments in a cave at Engihoul, which are valuable as evidence. The cave contains a bed of porous and pebbly silt, varying in thickness from two to three feet, under which lies a layer of stalagmite less than two inches thick, and it was while examining the soil beneath the stalagmite that the fragments in question were found. They consist of portions of two lower jawbones and three pieces of skull. In each jawbone the last three molars remain, all but two of which are much worn, and one is decayed. The pieces of skull are identified as fragments of the occipital and parietal bones; one of the latter is remarkably thick (eight millimètres). Pains were taken at the time of the discovery to observe that in their colour, degree of decomposition and position, the human bones were in no way to be distinguished from the other animal remains which were confusedly accumulated under the stalagmite.

Mammalian Remains.—Numerous elephants' teeth were dug up some years since at Fisherton Anger, near Salisbury. (Preface to Miss Benett's 'Catalogue of Wiltshire Fossils.')

Fossil Mammalia.—In the Museum at Leicester, are:—Teeth of *Elephas antiquus* (?), from the gravel at Barrow-on-Soar, found in 1858; *E. primigenius*, from the gravel at Wellingborough, Northamptonshire, found at a depth of 13 feet; ditto, from near Kegworth; ditto, found at Leicester, on the site of the Infirmary.

Leighton Buzzard:—*Elephas primigenius* (molar, tusk, and part of a leg-bone), found in 1860, at Mr. Doggett's gravel-pit, at the end of Leake Street, Leighton Buzzard.

A molar of *Elephas*, found in gravel on the banks of the canal, not far from Linslade Church, near Leighton Buzzard, is in the Museum at Oxford.

T. R. J.

FOREIGN INTELLIGENCE.

The publication of the 'Animaux Fossiles et Géologie de l'Attique,' after the researches made by M. Albert Gaudry in 1855–56 and 1860, has been commenced. The first part treats successively of the quadrumana, carnivora, rodentata, pachydermata, ruminantia, edentata, aves, and reptilia of which he has found the remains. The second part is devoted to the geology of Attica. In the parts issued, the description of the *Misopithecus* of Pentelicus, with hypothetical details of its aspect and habits, is most interesting. This monkey was half a yard long from the head to the extremity of the pelvis, and 30 centimètres in height. These are the dimensions of this little macacus; its tail would have exceeded the length of its body, and it is more likely that it scrambled along the rocks rather than climbed trees; and that it lived in troops. It masticated like man, making the lower jaw glide inside the upper. At the period during which it lived, the temperature of Attica would appear to have been higher than at present. The work, edited by M. Savy, will extend to fifteen parts.

During the past month, Count d'Archiac has presented to the French Academy a map of the portions of Savoy, Piedmont, and Switzerland, in the vicinity of Mont Blanc, by M. Alphonse Favre, Professor at the Academy of Geneva.

REVIEWS.

Carte Géologique du Département de la Loire-Inférieure. Par M. Cailliaud. Leipzig: J. Rothschild.

It is with much pleasure that we notice so excellent a local map as the one before us by M. Cailliaud; the result of fifteen years of excursions, during which period that gentleman has paid close attention to every important excavation that has been made in the department of the Loire-Inférieure. The authoritative specimens, moreover, upon which he has founded the stratigraphical divisions of his map, amounting to upwards of four thousand, have been placed in the museum of Nantes, where they are not only a standing proof of the value of M. Cailliaud's labours but can also be usefully consulted by all who have any interest in the geology, the arts, manufactures, and agriculture of the district.

The geological constitution of the department affords two well-marked divisions. In the northern part more than a third of its extent belongs chiefly to the transition rocks; the line of demarcation being east and west, following the Loire, Ingrande, to beyond Ancenis, Ligné, Blain, and Drefféar. The opposite portion, containing two-thirds of the area, is divided centrally by the valley of the Loire from east to west. Its chief geological features are primitive formations, or azoic crystalline rocks. No traces of volcanic rocks are met with. The rock divisions recognized begin with the lowest or Primary period; these are gneiss, crystalline micaceous schist, and granite, into which the former often pass by insensible gradations. In the quarries of Saint-Gervais the granite is seen partly stratified; and protogen granite is observed at Sorinières. The ordinary direction of the granite and gneiss is N.W. and S.E. The map shows 36 granitic regions; 16 of eurite, more or less porphyritic; 20 of amphibolite; 59 serpentine; several traps; 25 of Lydian quartz; 10 of diorite and eclogite, the latter containing garnets. M. Lory has described, in the Transactions by the French Geological Society the occurrence at La Paquelais, near Monitoir, of a leptynoid and granitoid gneiss in regularly bedded and almost vertical strata.

Next are noticed the rocks of the "Période Phylladienne." The Silurian rocks occupy a sixth of the area of the northern part. Numerous open mines of hydroxide of iron are worked. The prevailing direction of the beds in the west of the department is W. 10° to N.E. 15°, 10° to 15° S., plunging 45° to 50° to the S.E. A band of silurian quartzite is found towards the north, and a limestone-marble is met with at D'Erbray and Saint Julien de Vouvantes, belonging to the Lower Devonian.

The Upper Silurian, in its vicinity, is said to contain masses of crystalline marble distinct from the Devonian limestone, and bearing fossils characteristic of the third Silurian fauna of Barrande. Other Devonian beds occur at Ingrande, Ligne, and the banks of the Loire, etc. Half a kilomètre N.E. of Brulis the schist-zone envelopes a second calcareous marble; and at Ecochère the grey or pinkish rock is often mingled with beds of greenish schist. This deposit is considered to be middle Devonian by Dr. Bureau, who has found in it some good fossils characteristic of a higher level than that of Brulis.

North of Ancenis Upper Devonian rocks occur; and north, again, of these beds is the argillaceous sandstone known as grauwacke, with quartzose pudding-stones and clay nodules. The superficial portion of these rocks shows vestiges of anthracitic schists and impressions of plants. Anthracitic deposits occur at Doué in Anjou, at Effeteric, and Malabrit;

and amongst the vegetable fossils, *Pecopteris aquilina* and various *Nerropteris* are recorded. Up to this point the geological succession of the formations has been unbroken; but on coming to the Secondary period we find the Permian, Triassic, and the Jurassic, or more than three-fourths of the Secondary division, missing. The upper part of the Secondary deposit is however found at the forest of Touvais, where the cenomanien beds of the cretaceous formation appear; the white chalk, so common in ascending the Loire, in Touraine, being wanting in the department. The Tertiary age is represented by the Lower Eocene at Machecoul, Campbon, and other places; and the Upper Miocene at Vieillevigne, Laroux, Rottereau, etc. The upper Tertiary or Pliocene is absent. Of the quaternary deposits, the lower drift, marsh turbaries, and river-deposits are met with, spread as usual superficially over various portions of the district.

The topography of the map is seemingly very good, and as the number of geological explorers of this interesting region must necessarily be proportionately small, we trust that M. Cailliaud will find his labours pecuniarily rewarded by the purchases by other travellers, to whom this map will prove a very useful companion for other than geological purposes.

Die Wunder der Urwelt, eine populäre Darstellung der Geschichte der Schöpfung und des Urzustandes unseres Weltkörpers, etc. By Dr. W. F. U. Zimmermann. 8vo. Berlin. 1861.

The eighteenth part of this popular German treatise is before us, and is devoted to palæontology and astronomy. It forms one of a cheap elementary series, each part price 8*d.*, and composed of forty-eight pages. The typography and paper are rather better than the average in compilations of the class; the letterpress and illustrations much worse. This can be imagined when we inform our readers that the figure on page 5 of "*Elephas primigenius* (*vorweltlicher Elephant*)" is that of the *Mastodon Ohioticus*, although very badly drawn, especially in the knee-joints, and with an artificial eye put in the wrong place. A woodcut on page 16 is given, exhibiting a flint and a magnified *Xanthidium* by its side, which is labelled "*Feuerstein mit Seestern*," while on the same page the triassic star-fish has the name "*Seestern*" more correctly applied to it. On page 8, the two human skeletons from Guadaloupe are drawn side by side, but on wholly different scales, the one which is copied from Cuvier's 'Ossemens Fossiles' being about double the size of the drawing from the British Museum specimen. The impression which Dr. Zimmermann is kind enough to tell us he means for an "Unterkiefer eines Alligators," and which is, no doubt, *Alligator Hantoniensis*, is perhaps the worse specimen of engraving we have ever seen, except the *Plesiosaurus* on the same page. The following statement is made :—"*Einem Ungeheuer dieser Art gehört das unter dem Namen Hydrarchos gezeigte Knochengerüst von* 120 *Fuss Länge.*" The author is evidently not aware that later observers have reduced this 120 feet to 70. The best and only diagram of the earth's strata which Dr. Zimmermann is able to give, is the section of the artesian well at Pentonville; above which, a picturesque landscape of high mountains, a distant village, poplar-trees, and a railway train *à l'Allemande* are proudly displayed. But the vignette on page 1 is most remarkable. It represents an encounter between a miner armed with a pick, and a gigantic skeleton of something between a Pterodactyle and a jackdaw. The whole thing is so fearfully grotesque, that we must forbear to harrow our readers' feelings with its description. The cover of the work is a golden blaze of Palæontology, and is covered with

Plesiosauri spitting fire, Iguanodons with hook-noses, Pterodactyles which look wondrously like storks, and Hawaiian volcanos bubbling away merrily at the risk of engulfing the fossil scorpions at their brink. We hope that our German palæontologists really do not seriously promulgate this work in the hope of its diffusing elementary instruction amongst the masses of that profound-thinking nation.

Ueber Placodus gigas, Agassiz, und Placodus Andriani. By Dr. Carl Friedrich Wilhelm Braun. 4to. Münster: Bayreuth. 1862.

The work before us contains a detailed monograph of this most interesting genus, which was demonstrated by Owen, in the year 1858, to be a reptile, and removed from the class of fishes with which it had been classified by Agassiz. The most interesting and novel part of the work is the following statement:—

"We find in the muschelkalk of the hill at Leineck peculiar flat, broad, polymorphic, small or large masses, sometimes a foot in length. They are composed of bluish-grey flint, in which are embedded numerous small particles of a darker colour, composed of the fossilized débris of shells, not larger than one line each. Examined microscopically, we detect a structure which leaves no doubt that they are the fragments of rather small and very convex shells. Sometimes we can also distinguish single teeth and scales of fishes of the same formation, namely, *Psammodus, Hybodus*, and *Acrodus*. We cannot doubt that these siliceous masses are coprolites, which must belong to *Placodus*, for no other saurian or fish of those triassic strata has been provided with a dentition adapted to crush hard shells, like those of *Terebratula.* The *Placodus* fed on hard-shelled mollusca, and occasionally on fish. It is interesting to compare Owen's views on the nature of the food of those animals with our account, and to see how views gained from very opposite points of examination may perfectly agree in the final result. R. Owen, guided by the arrangement and the structure of the teeth, gives us the following ingenious explanation."

Then follows the well-known passage from Prof. Owen's memoir, read before the Royal Society, the accuracy of which induction is corroborated by the German palæontologist.

Aperçu Géologique du Département de la Moselle. Par C. Fridrici, Professeur aux Écoles Municipales de Metz. Leipzig: J. Rothschild. 1862.

An unpretentious little book, in a paper cover, illustrated with woodcuts of the most ordinary character, and creditable only, as engravings, to an engraver's youngest apprentice. But we do not mean to laugh at them either, although one of them *is* printed upside down; anybody can see that, because houses do not adhere to roofs of caverns, but point their chimneys upwards in the air. "In producing this book," says the author, "we do not pretend to offer a complete study of the geology of our department; it is simply a *résumé* made in the hope of its being useful to those of our pupils who, after having followed our lessons, would wish to make in our country application of that which they have learnt." Indeed, Monsieur Fridrici, we have a respect for your humble little *brochure*, and if English schoolmasters would do as much, and as well, for their pupils as you have done for yours, we should have more and better young geologists than we have. Sincerely we echo your wish, that your efforts may bring forth the fruits you desire.

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LIST OF PLATES.

LIST OF WOODCUTS.

END OF VOL. V.

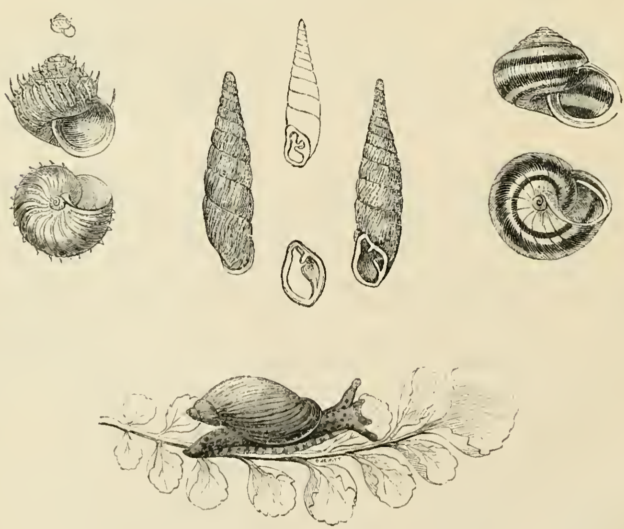
JOHN EDWARD TAYLOR, PRINTER,
LITTLE QUEEN STREET, LINCOLN'S INN FIELDS.

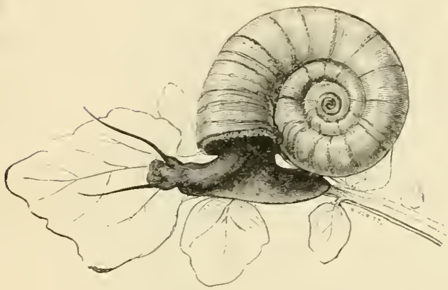
British Conchology has never been studied in this country except with limited views as to its bearings with the conchology of other parts of the globe. I had, moreover, two other reasons for endeavouring to turn my collection of British Conchology and experience of Foreign Conchology to account;—there has been an urgent want for some years past of an inexpensive manual, that might be generally available to students, and illustrations of the living mollusk are also wanted of more definition than mere outline sketches.

With these three points in view, namely, cheapness, good illustrative figures, details of foreign distribution, I have commenced with the land and freshwater species, making it a book complete in itself, in order that the marine species may remain open for future consideration. Thanks to the Rev. M. J. Berkeley, and to the painstaking research of my artist, Mr. O. Jewitt, I have been fortunate in obtaining figures from the life of most of the genera. To complete the series, I have availed myself of some of the animal figures of Moquin-Tandon. The shells of all the species, from two to four views of each, have been drawn by Mr. Sowerby.

It may be thought by some, that I have been unnecessarily long in the preparation of so small a work, but, though limited to only a hundred and twenty species, I could not have accomplished it to my satisfaction in less time. Three seasons have been devoted to the collecting of as many living specimens as possible; and I have worked out and published extensive monographs of foreign species, for the sake of showing the bearings of each on its representatives in Britain. In some cases, *Vitrina* for example, as many as eighty foreign species have been separately examined in order to arrive at a knowledge of the representatives in other parts of the world of a single British one.

Specimens of the Engravings.





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